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Copper Mines and Smelteries of Shasta County

Topography Favors Mining through Adit Levels; Cost of Mining $1.65 to $2.50 per Ton; Cost of Copper 8 to 10.25 Cents per Pound

BY GEORGE A. PACKARD*

Shasta county is one of the most northerly counties of California, being separated from Oregon by Siskiyou county. Redding, the county seat, is 260 miles north of San Francisco. The climate is agreeable, though the valleys are hot in summer. Except on the highest mountains there is little snowfall. The annual rainfall varies from 35 in. in the valley toward the south, to double that quantity in the mountains to the north. This precipitation takes place largely during the winter months; in January, 1909, it reached an abnormal monthly total of 40 in., 9 in. being recorded in one day at Kennett, where the mammoth smeltery is situated. This precipitation interfered seriously with transportation, even the old main line of the Southern Pacific railroad being operated only intermittently, while the newer lines from the mines to the smelteries were more seriously interfered with.

Water Power

To the north and east, on the high peaks of Mount Shasta and the Lassen buttes, this precipitation is in the form of snow and furnishes an all-the-year-round supply of water in the Pitt, McCloud and Sacramento rivers and their tributaries. This results in cheap power, which is developed and sold in the district by the Northern California Power Company and the Shasta Power Company. The plant of the former is of especial interest in that the power is derived from two small streams, each having a fall of 1200 ft. On a third stream a wheel now being installed to utilize a 525-ft. fall will develop 4000 kw., and below this on the same stream another wheel will develop 6000 kw. from a fall of 370 ft. Pelton and Doble wheels are used. C. F. Elwell[1] refers to the cost of this power to the Noble Electric Steel Company as $16 per kilowatt-year, but the power company is interested in the steel plant, and other plants are supposed to pay between $40 and $50 per horsepower-year.

Topography and Geology

From the stream fall mentioned it is easily seen that the topography, at least in certain parts of the district, is favorable to mining through adit levels; and this is especially the case with the mines to the west of the Sacramento river. East of this river, and as far north as the Pitt, the country is less deeply eroded

MAMMOTH MINE, KENNETT, CAL.

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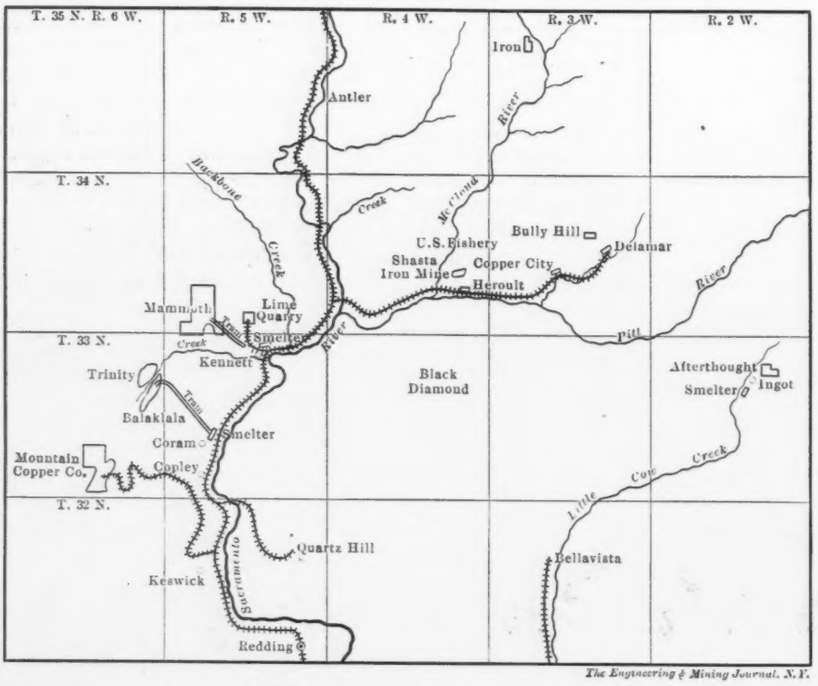
[1]"Tests on Electric Smelting of Iron Ore," *Journ., Electricity, Power and Gas*, XXI, p. 331, 1908.

by streams. Nor has there been much mining east of Redding. In fact, looking at the "Map of the Mining Districts of the Western States," issued by the U. S. Geological Survey, one receives the impression that the entire zone of mining districts, if it may be so termed, has been faulted along an east and west line, in the vicinity of Redding, and transferred 10 miles west, from the Sierra Nevada to the Coast range.

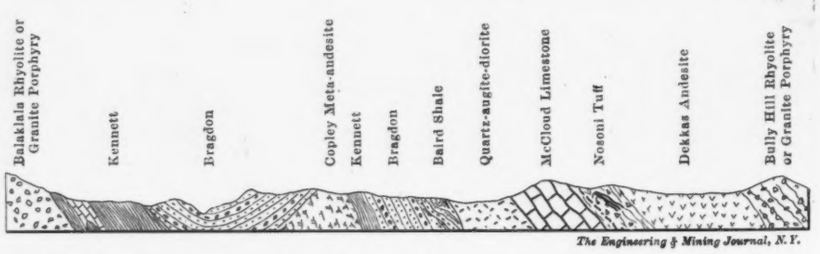
The railroad from San Francisco traverses the Sacramento valley which, until Redding is left behind, is broad and level. Beyond Redding the valley rapidly narrows and on either side rise steep slopes covered with brush and oaks, which give place to pines near the summits. The copper mines occur in these mountains in two wide irregular areas of granite porphyry, one on each side of the Sacramento river. These areas are separated by eight miles or more of sedimentary and igneous rocks. The Redding quadrangle presents an interesting section across several thousand feet of Devonian, Carboniferous, Triassic and Jurassic sedimentaries, made up of slates, shales, sandstones, limestones and tuffs, with interbedded and intruded igneous rocks. The whole series has been uplifted, sheared, faulted, and compressed, and shows in general a sharp dip to the northeast.

An accompanying section gives an idea of the geological conditions along an east and west line, the geology of this quadrangle having been mapped by Dr. J. S. Diller[2]. Of the sedimentary formations shown, the Kennett has been assigned to the Devonian and the others to the Carboniferous. Overlying the Bully hill granite porphyry, and not shown in the figure, is the Pitt shale of the Triassic period. In this folio the crushed granite porphyries containing the copper ores have been considered as rhyolite flows of different periods, and Dr. Diller assigns the Bully hill rhyolite to the Triassic, while most of the porphyry west of the Sacramento river, termed Balaklala rhyolite, he considers Devonian, though he states that some of the dike-like masses west of Copley may belong to the Triassic. Basil Prescott, who has made a study of the region between the Sacramento river and Bully hill, apparently agrees with Dr. Diller in so far as this eastern area is concerned[3].

Dr. L. C. Graton, in describing these deposits briefly, says[4]: "The orebodies are invariably associated with intrusive stocks of quartz monzonite porphyry, although the ore in some places extends out into adjoining rocks." In much of this rock the quartz phenocrysts are so prominent, and the ground mass is so compact, that rhyolite would appear to be the natural field term; but doubtless microscopic study has shown that the rock is more properly termed a granite porphyry, and is an intrusion rather than a flow, since this name is preferred by those who have given the most attention to the geology recently.



SKETCH MAP OF PORTION OF SHASTA COUNTY, CAL.



EAST AND WEST SECTION ACROSS PORTION OF REDDING QUADRANGLE (AFTER DILLER)

ORES

The copper ores and associated minerals are only the same in part, in the two areas, while the structural character of the ore deposits is also somewhat dissimilar, tending to the conclusion that the ore deposits were not formed simultaneously; or, if the copper minerals were originally deposited under similar conditions in both areas, subsequent conditions have been dissimilar. The ore occurs in zones of crushing and shearing in the granite porphyry, and locally in adjoining shales on the west side of the Sacramento, and in an intruded basalt on the east. The occurrence in the eastern area is so different that it will be described by itself later.

From the relative location of the orebodies it is evident that the porphyry in which they occur has, in the western area, been faulted to a considerable extent since they were formed. This is well shown in the section marked "E-F" in the annual report of the Balaklala Consolidated Copper Company for 1908, reproduced in the JOURNAL of March 6, 1909, p. 503. On a line from south to north the Weil, Windy creek, and Bull orebodies are shown, each below the preceding. If this section were continued it would show, perhaps 1000 ft. further north and considerably lower, the orebodies of the Shasta King mine. Squaw Creek, between the Balaklala and the Shasta King, apparently follows an east-west fault line, and N. R. Bishop of the Balaklala states that nearly every gulch on the surface is indicated underground by a fissure or fracture, though not necessarily a fault, and that near the north and south fissures the orebodies become larger and better.

The ores on the west side of the Sacramento are a mixture of pyrite, sphalerite and chalcopyrite, in which the

[2]Redding Folio No. 138, U. S. Geological Survey.

[3]"Magnetite Ores of Shasta County, California," *Economic Geology*, III, p. 465, 1908.

[4]"Mineral Resources of the United States," 1906, p. 392.

pyrite largely predominates. Some chalcocite and covellite are found and the ore carries varying, but rather small, quantities of gold and silver. It is evidently a replacement of the granite porphyry. In the Mammoth and the Iron Mountain mine of the Mountain Copper Company, this replacement has gone so far that much of the ore mined and sent to the blast furnaces contains as high as 40 per cent. sulphur and only from 5 per cent. to 12 per cent. insoluble silicious residue. The Balaklala also has large bodies of similar ore, though the general average of the ore at this mine is lower in iron and sulphur, and bands of rock high in silica occur.

The orebodies themselves have been compared by A. S. Haskell, the manager of the Mammoth, to a series of overlapping lenses of irregular size and shape, separated by tongues of less mineralized porphyry.

These orebodies are closely associated with well-defined fracture planes having various strikes within the shear zone. They contain from a few, to many thousand, tons of ore. In general the orebodies are roughly tabular in form, with a low dip to the west in the Mammoth and Balaklala. They are commonly bounded by well-defined fissures, frequently marked by a clay gouge, though sometimes the mineralization appears to

Naturally in a region where the temperature reaches 100 deg. in the shade, and the rainfall is 65 in. per annum, such heavy sulphide ores, where exposed, have been oxidized and leached, resulting in large areas of gossan on the surface, and zones of secondary enrichment below. The most prominent of these outcrops is that at the Iron Mountain mine, where the gossan has an extent of several hundred feet. Dr. Graton[6] refers to the zone of secondary enrichment underlying this gossan as having been wonderfully productive of copper and silver at Iron Mountain and Bully hill, but now about exhausted, and practically absent in the other mines. The thickness of

LIME QUARRY, MAMMOTH COPPER MINING COMPANY, KENNETH, CAL.

GRAVITY TRAMWAY, 64 PER CENT. GRADE, MAMMOTH MINE, KENNETT, CAL.

Near the fissure planes the silicification and alteration of the granite porphyry frequently obscures the porphyritic appearance. Even in the sulphides, however, "The presence of crystalline quartzphenocrysts from the rhyolite" may be shown by dissolving the ore.[5] Not all the porphyry within the shear zone has been replaced by sulphides or silica and small patches which have escaped impregnation sometimes occur between seams in the solid sulphide ore. fade off into the porphyry beyond the fissure bounding the solid ore. As a result of these sharply defined limits it is possible to determine ore reserves with considerable exactness. Thus, James D. Hague, in his report made at the time of the organization of the Mountain Copper Company, said: "The orebody has been developed with unusual thoroughness and its actual dimensions are known beyond doubt." Similarly, the Balaklala company has today one orebody roughly 1000 x 300 x 50 ft. in a block which is perhaps delimited on four sides by fault planes.

the ore deposits west of the Sacramento varies in the different localities. Weed[7] says that the Iron Mountain has been worked to a depth of 600 ft. The present estimate for one point in the Balaklala is less than 50 feet.

These flat orebodies west of the Sacramento lend themselves excellently to prospecting with drills, and one company alone has done many miles of this work. From the fact that some of the managers speak of "acres of ore" it may be pre-

[5] "The Copper Mines of Shasta County, California," D. F. Campbell, *Min. and Sci. Press*, Jan. 5, 1907, p. 28.

[6] "Mineral Resources of the United States," 1906, p. 393.

[7] "Copper Mines of the World," p. 302.

sumed that this drilling has not been unsatisfactory.

Bully Hill District

East of the Sacramento river the orebodies have more of the nature of veins and are nearly vertical. I did not visit the Afterthought district, but understand the occurrence there is similar to that at the Bully hill, with perhaps more zinc. In the Bully hill district the ore occurs in a shear zone on a contact of the granite porphyry with a later basaltic rock, and in parallel shear zones, in both the basalt and the granite porphyry, but more especially in the basalt. The latter orebodies are of higher grade, and also carry silver, which is absent in the orebodies in the porphyry. Pyrite, which is so prominent west of the Sacramento, is less noticeable here.

The copper occurs not only as chalcopyrite but also as bornite and chalcocite, mixed with a large amount of sphalerite and some galena. More or less barite occurs, which carries up to three ounces of gold. Native silver is also found occasionally in the barite, and the galena carries both gold and silver. No gold is found with the blende. From the above it may readily be seen that east of the Sacramento, there is no definite ratio of gold and silver content to copper. Apparently secondary enrichment has played a much more important part here than west of the Sacramento, and the high-grade ores continue to greater depths. Compared with the western area the orebodies are much smaller. I should say 25 ft. was the thickest orebody I saw.

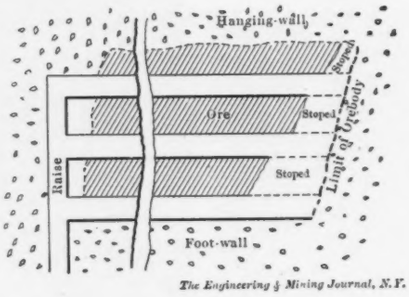
Genesis of Orebodies of Shasta County

The genesis of the Shasta county orebodies has been discussed by William Forstner[8], who reasons that since "No intrusives have been ascertained in the Balaklala rhyolite, the copper in the solution must then either have been derived from underlying formations, or have been leached out of the rhyolite." In view of the presence of basic intrusives in the Bully hill area he offers the hypothesis that a magmatic differentiation has taken place, and the basic material, intruded in the Bully hill porphyry, but perhaps underlying the Balaklala porphyry, has supplied the copper to the ascending solutions. I believe recent investigations have indicated the presence of later dikes in the Balaklala area, and as a detailed examination of this district is now being made by the U. S. Geological Survey we may expect to have a more complete statement of the geological conditions.

According to the Government report[9] the production of Shasta county for 1907, during which year the Balaklala and Bully hill smelteries were not in operation, included 288,578 tons of copper ores which yielded 23,457,417 lb. of copper, or an average of 4.06 per cent. These ores are also credited with 13,208 oz. of gold and 518,791 oz. of silver, or an average of 0.045 oz. gold and 1.7 oz. silver per ton, but this includes the precious metals derived from the silicious fluxes.

The Iron Mountain Mine

The oldest of the large copper mines is the Iron Mountain mine which is now owned by the Mountain Copper Company. It was exploited in 1880 as a large silver mine and in 1884 was equipped with 20 stamps and a pan mill for amalgamating the gold and silver contained in the gossan. Since 1895 it has been owned by English interests and worked for copper. The early reports show that the ore below the gossan aver-



PROPOSED METHOD OF MINING AT BALAKLALA MINE

aged about 7 per cent. In 1907, according to D. F. Campbell[10], the ore averaged 6 per cent. copper, $1 in gold, 1½ oz. silver, and 48 per cent. sulphur. The original orebody as reported by Hague is now pretty well worked out. The company, however, owns much additional ground and has several million tons developed in the Hornet claim. While this ore does not average as well in copper as that in the Iron Mountain, it is high in sulphur. The mines are opened by tunnels from which an electric road delivers the ore to the bins above the narrow-gage steam road owned by the company and connecting with the Southern Pacific.

Mr. Campbell describes the method of mining[11] as a slicing system in which the mine is divided into pillars 50 ft. square. These pillars are robbed by horizontal slices one set wide, 10 ft. thick, and the openings are timbered and filled, no opening more than two sets wide being allowed to exist at one time. To lessen the danger of damage by fire from which the mine has suffered in the past, a pillar is left standing across the entire orebody, separating the two end stopes. The cost of mining is said to be $1.50 per ton.

Smelteries of the Mountain Copper Company

The Mountain Copper Company owns two smelting plants, one near the mines at Keswick, and one at Martinez on San Francisco bay, built after litigation on account of fumes had closed the Keswick plant. Recently the litigation has been settled and it is announced that the Keswick plant may be started again. When I first visited this district nine years ago the ore was roasted in heaps and smelted in cupolas. Subsequently pyritic smelting with the use of a hot blast, from stoves heated with oil, was developed. The ore reserves now contain less copper than the ores formerly worked, and the resourceful management, which has successfully fought strikes, fires and litigation, has developed a scheme for utilizing the high sulphur content in making sulphuric acid and fertilizers. The ore is roasted in furnaces of the MacDougal type. The matte is converted and the copper refined at the Martinez plant. A foundry is operated at Keswick, which also makes castings for neighboring mines.

Balaklala Consolidated Copper Company

The Balaklala group, situated about four miles northeast of the property of the Mountain Copper Company, comprises 1150 acres, besides a smelter site, the townsite of Coram and the tramway right of way. The property is operated by the Balaklala Consolidated Copper Company, the stock of which is owned by the First National company. The first discovery of ore was made where the sulphides outcrop in the creek, and there is little gossan here. Another similar outcrop is now being developed on a creek further east. The property has been prospected with drills, and is opened by a number of tunnels, which have exposed four orebodies, or portions of the same orebody separated by faulting. In one place a block of ore has apparently been thrown downward below the ore on the south, east and west sides. The greatest thickness of these orebodies is about 60 ft. Plans and sections are shown in the 1908 report.[12]

The reports of the company show something over one million tons of ore averaging 2½ per cent. copper, 50c. in gold, and 0.8 oz. silver, actually blocked out, with much more than this indicated

[8] *Min. and Sci. Press*, May 18, 1907, p. 625, "Copper in Shasta County, Cal.," and Aug. 22, 1908, p. 261, "The Genesis of the Copper Ores in Shasta County, West of the Sacramento River."

[9] "Mineral Resources of the United States," Part I, 1907, p. 222.

[10] *Min. and Sci. Press*, Jan. 5, 1907, p. 28.

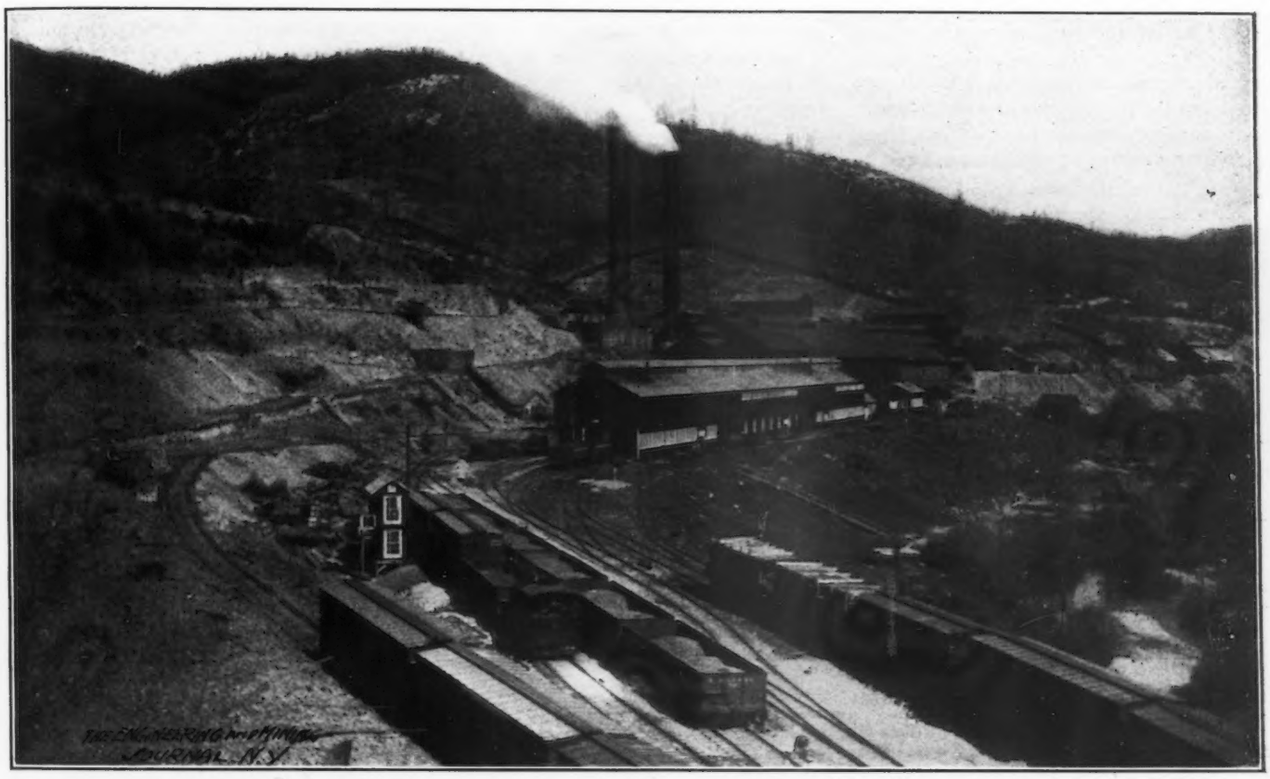
[11] *Min. and Sci. Press*, Jan. 12, 1907, p. 55.

[12] Eng. and Min. Jour., Mar. 6, 1909, p. 501.

from prospecting already done, and a considerable area not tested. The Balaklala ore differs from the ore of the Mountain Copper and Mammoth companies in that it averages nearly 30 per cent. silica. As the mine has large bodies of both high iron and high silica ores, it should be possible to secure any desired smelting mixture without purchasing fluxes other than lime. The upper orebody is quarried on the surface and delivered to the Weil tunnel, as is also the ore mined through the Windy Camp tunnel, connection having been made through a 240 ft. raise. The Weil tunnel is the main working tunnel, and from it the ore is delivered to the mine ore bins by five-car trains drawn by electric locomotives. The Bull orebody lies below the level of the Weil tunnel.

At the time of my visit mining operations had not progressed sufficiently to permit an inspection of the mining method which is proposed, as all of the ore at that time came from preparatory work. Manager Bishop has run tunnels below the orebodies, upraising at intervals in the country rock near the edge of the orebody, and from these raises he proposes driving a series of drifts, one about 15 ft. above the other, across the orebody to its farthest limit, the number of drifts depending on the thickness of the deposit. A modified slicing system of mining will then be used, the ore being mined back from the face a little faster in each drift than in the one above, as shown in an accompanying sketch.

At the same time the ore will be cut out on each side until connections are made with the slice being removed from the next series of drifts. All ore will be trammed through the lowest drift. The ore and the roof are both hard and stand well. The ore is delivered from the mine bins to the smelter by a wire-rope tramway, built in two sections and having a 1½-in. cable for loaded and 1¼-in. for returning buckets, with a 1-in. traction rope. The buckets hold 1500 lb. and as the grade is heavy great care is necessary in controlling the speed. Ultimately it is hoped to operate at 500 ft. per min. The length is about three miles.



MAMMOTH SMELTERY, KENNETT, CAL.

The Smeltery

The Balaklala smeltery, at Coram, on the Southern Pacific railroad, was described in the Journal of March 6, 1909. Briefly, it consists of four MacDougal roasters, three blast furnaces, one reverberatory and two converter stands. Up to January but a small portion of the plant had been put in commission, only one furnace being in operation most of the time. The ore treated in 1908 amounted to 15,960 tons, from the Balaklala mine, having an average content of 2.53 per cent. copper, 0.016 oz. gold and 0.71 oz. silver.

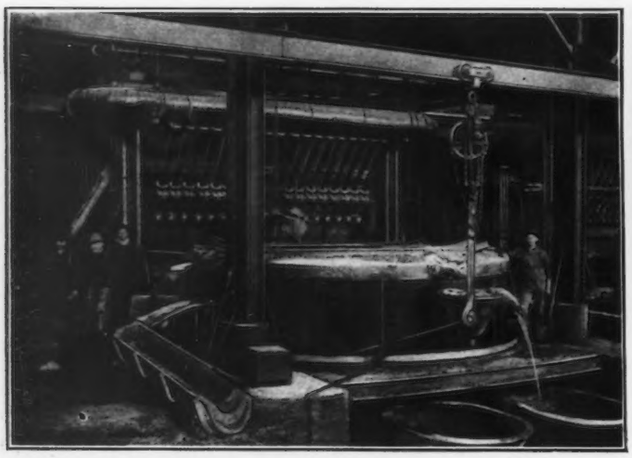
The Balaklala smeltery also receives the ore from the Shasta King mine of the Trinity Copper Company, adjoining this property on the north. The Shasta King is opened up by tunnels several hundred feet below the level of the Balaklala, and on the opposite side of Squaw creek. The ore is hoisted up an incline track 850 ft. long, and with nearly 45 deg. slope, to bins beside the mine ore bins of the Balaklala, from which it is delivered to the smeltery over the Balaklala tramway. At the time of my visit 200 tons per day were being treated. The Balaklala report shows that 7286 tons of this ore treated in 1908 averaged 2.78 per cent. copper, 0.032 oz. gold and 1.02 oz. silver per ton, which is about $1.10 better than the Balaklala average for the same period.

Mammoth Copper Mining Company

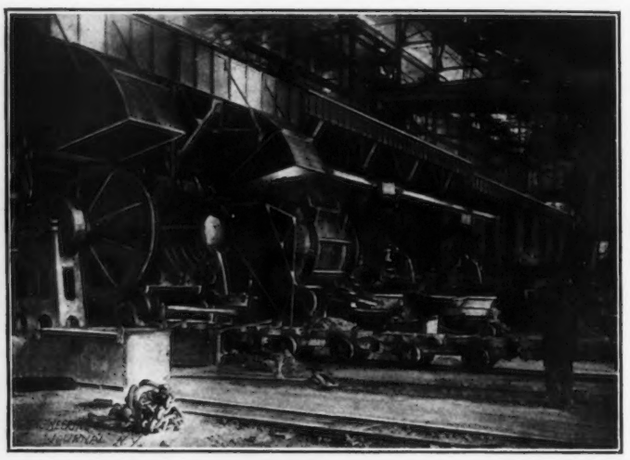
The Mammoth Copper Mining Company is a subsidiary company of the United States Smelting, Refining and Mining Company. Its mining property, over 1000 acres, lies about three miles northeast of the Balaklala. The workings from which ore has been mined extend vertically to a depth of about 190 ft. from the surface. The ore now being mined does not come from below a gossan outcrop of prominence, and there is little secondary enrichment. It averages about 4½ per cent. copper, 80c. gold and 2 oz. silver, or 2c. in precious metals for each pound of copper. It contains up to 12 per

cent. insoluble, about 40 per cent. sulphur, and an average of 4 per cent. zinc.

The ore is mined by a slicing and caving system. An interesting method of firing the caving holes by electricity, using a current in parallel, has been developed so that 400 holes may be fired together satisfactorily; though at present the roof is caved twice a week and a smaller number of holes required. Formerly this was done by hand, and 70 to 80 men used. Four hundred men are employed in the mine and a product of three tons per man per day obtained. The mine is operated through tunnels, all of the ore being delivered to the lowest, from which it is hauled over an electric road about one mile to the head of a gravity tram. This tram is 4500 ft. long, with a drop of 1500 ft. The ore is delivered to a standard-gage railroad, over which it is hauled two miles to the smeltery bins. Fines amounting to about 100 tons per day, and carrying over 40 per cent. sulphur, are screened out and shipped to the Peyton Chemical Company, where they are used for acid making and the residue smelted.



NO. 4 FURNACE, MAMMOTH SMELTERY, KENNETT, CAL.



CONVERTER POURING COPPER; PART OF MAMMOTH SMELTERY

Mammoth Smeltery

The Mammoth smeltery is situated at Kennett. A complete description has been given by the manager, A. S. Haskell.[13] There are five blast furnaces, each 180 in. long. Three are 50 in., one is 53, and one 56 in. wide, all having been increased from the original width of 42 in. The increase to 56 in. gave an additional capacity of nearly 20 per cent., somewhat below the percentage increase in width. There are 16 tuyeres on the front, and 18 on the back, each 3¾ in. in diameter. A cold blast with 42 oz. pressure is used, and coke equal to about 4 per cent. of the charge. Coke is bought from Washington, Utah, Australia, Scotland, Germany and rarely from Pennsylvania, the place depending on the market conditions.

The ore is too zinky to permit of smelting with hot blast and practically no coke, as was formerly done at the Mountain Copper Company plant. The furnaces formerly had brick tops which gave much trouble on account of zinc incrustations, but water-jacketed tops have now been adopted and the difficulty has disappeared. The furnaces are run with a 9-ft. ore column and rather hot top. One furnace was being rebuilt at the time of my visit; the other four were handling 1000 tons of raw sulphide ore per day, two running on raw ore alone, making low-grade matte, and two running on raw ore and low-grade matte, making a converter matte.

The first matte runs from 20 per cent. to 25 per cent. copper and the second from 35 per cent. to 40 per cent. The slag carries 42 to 46 per cent. FeO, 35 to 40 per cent. SiO_2, and 8 to 12 per cent. CaO. There are two converter stands. The fluedust and fines are briquetted, no reverberatory being used. The ore received at the smeltery includes coarse ore, and some fines, from the company's mines, silicious gold ore from Quartz Hill, some custom ores, and the Bully Hill matte. The custom ores sometimes include ores from Nevada and Utah. The company has a lease on the Quartz Hill, a big low-grade gold quartz mine, and has built a narrow-gage railroad connecting it with the Southern Pacific. Lime is bought from the Holt and Gregg lime quarry although the company has purchased lime lands of its own.

Bully Hill Copper Mining and Smelting Company

The property of the Bully Hill Copper Mining and Smelting Company is situated in the porphyry area east of the Sacramento river, and about 14 miles east of the Mammoth. It comprises over 200 acres, and includes the Bully Hill, Rising Star and Copper City mines. In January there was little doing at the last property. These orebodies being nearly vertical offer less opportunity for exploitation by drilling than do the flat bodies west of the Sacramento, but there are fair reserves in the former two properties.

The gulches below these properties were productive placers in the '50s and later a stamp mill was erected in which the surface ores were treated. J. R. De-Lamar bought the property in 1899 and equipped it with a smelting plant. Later he turned it over to the General Electric people. By them it was developed until the ore in sight justified the construction of a railroad 15 miles long, connecting with the Southern Pacific. During the construction, for a period of two years, the property was practically closed down.

The Bully Hill mine has a shaft down to a depth of 970 ft., and the Rising Star to 800 ft. below the surface. Both are equipped with electrical hoists having a capacity of 1000 tons per day. The pump at the Bully Hill, a quintuplex with brass parts, pumping through a lead-lined iron pipe, was operating in January from two to four hours per shift, or about nine hours per day, equivalent to 20 gal. per min. In summer there is little water to pump. Copper is precipitated from the mine water here, and also at some other mines of the district.

The orebodies appear to be lens shaped, and arranged somewhat like the steps of a step ladder. At the surface there is not a large amount of gossan, and this is much more silicious than at the Iron Mountain. Secondary enrichment, however, has resulted in higher-grade ores than west of the Sacramento, and copper, gold and silver ore aggregating $100 per ton is sometimes encountered. At the lowest level of the Bully Hill, 970 ft. down, is a stope 20 ft. wide showing much chalcocite and high in silver. The

[13] "Copper Smelting at Mammoth Plant," *Mines and Minerals*, March, 1908, p. 392.

appearance of the ore, with the excess of zinc, lead and dark copper sulphides, is widely different from that west of the Sacramento.

By prospecting along the shear zone, new orebodies, which do not reach the surface, are encountered. These zones are much crushed and the mine is timbered with 10x10-in. square sets which are promptly filled with waste. Samples are taken at close intervals and much sorting is done, the rock too low to pay being left underground. The mine openings are irregular. As a result of the heavy ground and the handling of the ore the mining costs must be large. The Bully Hill was producing somewhat less, and the Rising Star somewhat more, than two tons per man employed underground, but more development was being done at the Bully Hill. On account of the long period of inactivity, conditions underground are undoubtedly worse at present than they will be later.

Ore Handling and Smelting

At the Bully Hill the ore is hoisted to the 320-ft. level and trammed through a tunnel 1000 ft. long to bins from which, and from the Rising Star, it is hauled over a narrow-gage road to the smelter bins. The Copper City mine is on the new broad-gage railroad. The fines are screened out and go to two MacDougal roasters, each handling 30 tons per day. They are provided with oil jets which are used occasionally from one half to one hour when roasting ore from the Bully Hill mine. That from the Rising Star contains more sulphur. The roasted fines and the flue dust go to a reverberatory 16x35 ft. A five-ton charge, mixed with lime when necessary, is delivered from two hoppers every two hours. Three oil jets connected with ½-in. oil, and ½-in. steam pipes supply fuel.

It is found that the sides of the furnace are cut out more rapidly by the slag when oil fuel is used than was the case with coal. The gases from the reverberatory go to a U-type stove in which the air for the blast furnace is heated. The blast furnace is 42x200 in. with 15 tuyeres on each side. To permit varying the air supply these are made 5 in. in diameter and bushed down. Formerly a 3½-in. opening was used, but this has been increased to 4 in. The blast pressure is 35 oz. and the hight of the ore column 8 ft. The furnace smelts about 350 tons of ore per day.

In January hand feeding had temporarily replaced the dumping of cars directly into the furnace. As a result it was necessary to run down and bar off crusts only once in three or four shifts, in place of barring down once each shift as in the past. The ore contains much zinc and at times the crusts have nearly closed the furnace, while with the new method they are small. The furnace top is an air-cooled jacket.

The ore carries an average of 20 per cent. sulphur, 23 per cent. silica and 4 per cent. copper. Manager Keating states that charges have been run containing as high as 27 per cent. BaO and 12 per cent. Al_2O_3 or 16 per cent. Zn. Iron gossan bought from the Mountain Copper Company is occasionally added. A common slag carries 36 per cent. SiO_2, 21 per cent. FeO, 9 per cent. CaO, 8 per cent. BaO, 12 per cent. Al_2O_3, and 8 per cent. Zn. The matte, which carries about 37 per cent. copper, goes to the Mammoth smeltery for converting. The management is certainly entitled to credit for solving such a difficult smelting problem as this ore furnishes.

Costs

The cost of living in Shasta county is lower than in many mining camps of the West, and underground labor is generally paid about 25c. per day less than in Montana and Colorado camps. The mines have the advantage of comparatively cheap power, and in many cases of mining through tunnels. Coke is not the best and is more expensive than in some districts, but it forms an unusually small percentage of the charge.

The Balaklala is the only one of these properties publishing costs, and this company has not yet reached a point where conditions are normal. For the short time in operation in 1908 the figures are $2.424 for mining, $0.304 for tramming, and $2.924 for smelting. They expect to mine at a cost of $2 per ton, to reduce to matte for $2.50 per ton of ore smelted, and to convert at 0.75c. per pound of copper. Accepting these figures, and adding 15c. for delivering the ore from mine to smelter, if the Balaklala ore yields 50 lb. of copper to the ton, we have a cost of 4.3c. per lb. of copper for mining and ore transportation, and 5.75c. for smelting and converting, or a total of 10.05c. per lb. of copper converted. To this must be added the cost of freight, refining and marketing. This can hardly be less than 2c. per lb. Crediting the copper with the value of the precious metals in the ore, about 1.75c. per lb. of copper, the cost of Balaklala copper will approximate 10.25c. per pound.

At the Mammoth the mining cost, including exploration, development and administration, is $1.65, and transportation of ore to the smelter costs 20c., or a total of $1.85 per ton. With a recovery of 80 lb. of copper per ton, this gives a cost of 2.3c. per lb., or a decrease of 2c. per lb., as compared with Balaklala, on mining and transportation alone. As the ore carries precious metals exceeding 2c. per lb. of copper, as compared with 1.75c. for Balaklala, an additional credit of 0.25c. per lb. is obtainable here; so that assuming other costs to be the same as Balaklala's, Mammoth copper would cost 8c. per lb. With its excellent management of longer experience, its ore of higher grade, its leased gold quartz mine and the connection with other large enterprises, Mammoth doubtless does better than this.

Bully Hill, with its complex ores and smaller production, must have higher costs, but these are perhaps offset by the higher content of gold and silver in the ore. The Mountain Copper Company, with the manufacture of acid and fertilizer, has become an industrial concern, no longer dependent upon the price of copper for its profits.

The Oak Creek section of the Yampa coalfield, on the Moffat road, in Colorado, has now four shipping mines: the Oak Hills company, fully equipped, preparatory to a 2000-ton per diem production; the James seam of the Prentice company, and the MacKinlay mine adjoining, both extensively opened but not yet fully equipped as to surface improvements; and the Juniper company, F. A. Craise, manager, also undergoing extensive underground development. This Routt county coal is being supplied to the Moffat road for locomotives, and is also for sale in Denver for domestic use, coming into competition with northern and southern coals, an important feature in the fuel supply of the inhabitants of Denver, and the State generally.

High prices for charcoal iron about 40 years ago are shown in an extract from the books of Jefferson furnace in the Hanging Rock district of Ohio, given by the Cleveland *Iron Trade Review*. These prices for 16 years were as follows:

Year.	Low.	High.	Year.	Low.	High.
1860	$27.00	$32.00	1868	$54.00	$57.00
1861	24.00	32.00	1869	54.00	61.00
1862	27.00	31.50	1870	52.00	56.00
1863	31.00	52.00	1871	50.00	58.00
1864	52.00	75.00	1872	58.00	60.00
1865	57.00	85.00	1873	57.00	60.00
1866	61.50	68.00	1874	53.00	61.00
1867	57.00	64.00	1875	.....	50.00

It must be remembered that these prices were in currency, in a period when gold was at a premium varying from 25 to over 100 per cent.

An article by Henry E. Birkenbine in the Cleveland *Iron Trade Review* calls attention to the fact, which few people now recall, that for over 30 years—1839 to 1873—iron was produced in the southern part of Illinois. At that time two blast furnaces were active in Hardin county, Ill., producing pig iron from local ores smelted with charcoal, and the ruins of these plants are still in existence. The ores used were carbonates and brown hematites which were found in a coal-bearing area.

The Treatment of Steel in Electric Furnaces

Superiority of Electric Furnaces Largely Due to Freedom of Product from Oxide, Suspended Slag and Perhaps Hydrogen and Nitrogen

BY HENRY M. HOWE*

In an admirable article in the *Revue de Metallurgie*,[1] C. Clausel de Coussergues describes and discusses at great length and in a most interesting way the treatment of steel in electric furnaces. In taking his paper as a peg whereon to hang a sermon my purpose is not so much to compare the various electric furnaces as to consider with him the bearing of the phenomena noted in these furnaces on our general ideas about the purification of iron, i.e., the removal of carbon, phosphorus, and sulphur, whether in the bessemer converter or the open hearth or electric furnace. In beginning, it may be well to point out that the processes carried out in these electric furnaces are not really electric processes. Electricity is used in them solely as a source of heat, and the purification is brought about by the same old means to the use of which in the puddling, bessemer, open-hearth, and blast-furnace processes we have so long been accustomed. That is to say, carbon, silicon, and phosphorus are removed chiefly by oxidizing them to carbonic oxide, silica, and phosphoric acid, by means of iron oxide either formed in the process itself with atmospheric oxygen, as in both the bessemer and open-hearth processes, or added in the form of iron ore as in the open-hearth and puddling processes. The sulphur is removed in part as sulphide of manganese, which distributes itself between metal and slag, quite as in the puddling, basic bessemer, and basic open-hearth processes, and partly as sulphide of calcium which passes apparently wholly into the slag, quite as in the blast furnace.

But though electricity is here used solely as a source of heat, it has the great advantage over other sources of heat that it can supply its heat without simultaneously introducing oxygen. In the bessemer process the blast which generates the heat acts essentially through introducing vast quantities of oxygen. The flame which supplies the heat to the puddling and open-hearth processes brings with it much oxygen, and even when it is called reducing it is in fact violently oxidizing to iron and most of the nonferrous elements which it contains. In the last analysis this freedom from oxygen seems to be the chief if not the only thing that gives the electric furnaces their advantage over others, as we shall see later.

The obstacle to the wide use of electric furnaces in iron metallurgy is the great cost of the electricity itself. It is true that these furnaces do their work of heating and melting much more cheaply than the crucible furnace does, but still they do it much less cheaply than the blast furnace, the cupola furnace, the bessemer converter, or the open-hearth furnace, and this will be the case in general until the exhaustion of our coalfields shall have greatly increased the cost of coal. In cases where power is to be had at a small cost, for instance, near the coke ovens of great metallurgical works, it may indeed be possible to heat and melt with electricity more cheaply than with coal; but even in these cases it will probably be more profitable to use the power as a basis for some other industry, and to continue to use the blast furnace, cupola, converter, and open-hearth furnace for decades if not for generations to come.

That so costly a thing as electricity should compete with so cheap and efficient a thing as the iron blast furnace for the smelting of iron ores seems hardly to be on the cards. It might have been possible 50 years ago, before coke could be carried so cheaply to almost every place where it is needed; but it is hard to think of conditions such as to make it cheaper today to use current than coke. In places so remote and inaccessible that coke cannot be brought to them, one fears that this very inaccessibility and costliness of inward freight must imply such corresponding costliness of outward freight that the iron smelted from ore by means of electricity cannot be exported with profit.

Thus the natural work of the electric furnace is to replace the crucible furnace and to supplement the work of the converter and open-hearth furnace.

What the Electric Furnaces Are

Electric furnaces may be regarded as large internally heated crucibles, or, if I may use the hibernianism, as closed open-hearth furnaces with the flame replaced

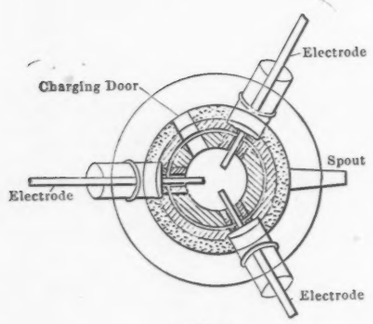


FIG. 1

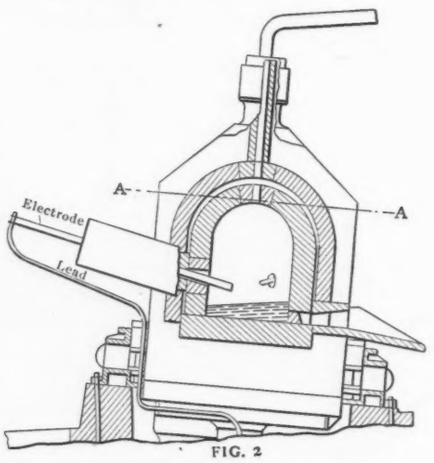


FIG. 2

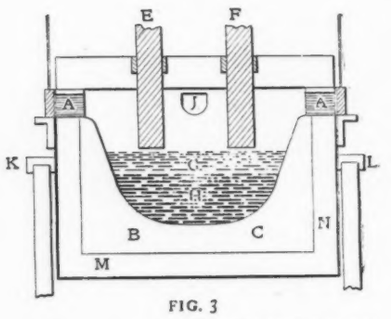


FIG. 3

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FIG. 1. TRANSVERSE SECTION A-A

FIG. 2. STASSANO FURNACE

FIG. 3. HEROULT DOUBLE ARC FURNACE

A A, working doors. *B C*, magnesite bottom. *E*, entering electrode. *F*, exit electrode. *G*, molten slag. *H*, molten metal. *J*, pouring spout. *K L*, trunnions. *M N*, outer brickwork.

*Professor of metallurgy in Columbia University.

[1] VI, June, 1909, p. 589.

either by means of electric arcs from carbon electrodes; or by means of a current of electricity which heats the bath by resistance, quite as in the case of common incandescent electric lights; or by both means. The treatment in these furnaces may consist of three distinct steps: (1) melting down; (2) oxidizing the phosphorus of the molten metal, and its carbon and silicon if any excess of these elements is present, by means of iron oxide; and (3) removal of suspended slag, etc., and deoxidizing and desulphurizing by deoxidizing agents, such as carbon, ferro-silicon, aluminum, and, most effective of all, by forming calcium sulphide in the furnace itself. Of these three steps, the third is the only one which seems appropriate to the electric furnace, because the first and second can in general be carried out more cheaply by other means.

Arc Furnaces

In the arc furnaces the current may either pass both inward and outward through carbon electrodes which pass through the roof, or through the walls above the bath, as in the Stassano and Heroult furnaces (Figs. 1, 2 and 3); or it may enter through such overhead electrodes and pass out through the bottom of the furnace, using the bath of metal as the lower electrode. Our natural fear is that this must endanger the bottom of the furnace, but abundant experience with the Giffre and Girod furnaces (Figs. 4 and 5) shows that this danger need not be serious. In the melting-down stage these overhead electrode furnaces (Stassano and Heroult) have the defect, which may be of moment, of having violent fluctuations of current, owing to the short-circuiting, the abrupt making and breaking of the arc, caused by the settling of the charge. From this defect the bottom-electrode furnaces (Giffre and Girod) are nearly free. This defect might be important in case the current used for the electric furnace formed a large fraction of the whole, because of the consequent abrupt fluctuations in the load on the generating machinery, unless it is practicable to build this machinery so that such fluctuations will not injure it.

Even in the arc furnaces an important part of the heat is generated by the resistance of the metal itself or of the slag, or of both, to the passage of the current. This seems to me to be true even of the Stassano furnace. It is true that other writers describe this furnace as heated solely by means of the arc, but according to my own observations, the arc itself, though it nominally passes wholly above the charge, actually short circuits in no inconsiderable part through the charge, especially during the melting down, with abrupt and wide variations in the current like those which occur in the Heroult furnace.

Induction Furnaces

In those resistance furnaces which have come into the widest use (the Kjellin and the Roechling-Rodenhauser, Figs. 6 and 7), the current which does the heating is induced in the molten metal from without, somewhat as a current of great volume, but low e.m.f. is generated from the currents of high e.m.f., by means of which the electricity is carried long distances from the source of power. Hence these furnaces are called "induction furnaces." The Roechling-Rodenhauser furnace has, in addition to the induced current, a current passed through the metal from electrodes buried in the walls.

The induction furnaces have the advantage over the arc or electrode furnaces, of avoiding all troubles due to the flaking off of the electrodes and consequent indeterminate carburizing of the metal at inconvenient times. But to-day the manufacture of electrodes seems to have been so far perfected that this trouble has ceased to be serious, unless perhaps in case of the Stassano furnace in which gravity throws a serious stress on the outstretched horizontal electrodes. The induction furnaces may perhaps have a further advantage in avoiding the local high heating of the molten steel where the arc strikes it. It is possible that this local heating, to which in the arc furnaces one part of the metal after another may be exposed, may cause some injury; but this is purely a matter of speculation.

On the other hand the induction furnaces now in use have limitations of their own. The Kjellin furnace consists of an annular trough which holds the molten metal, and in this ring of metal a current is induced by means of a central core. Now it appears that in order that any large fraction of the inducing current shall be utilized, this ring of metal must be of very small diameter, i.e., that the furnace must be on a scale so small as to put it almost out of the race.

A natural objection to the induction furnaces is that they do not melt their slag thoroughly, because they generate their heat within the metal, which in turn heats the slag, with the consequence that the slag is always cooler than the metal, instead of being hotter, as it should be, and actually is in the open-hearth furnace and probably in the electric-arc furnaces. Now in the normal practice of the electric furnaces, when a slag has become befouled with phosphorus or sulphur, it is removed carefully and thoroughly lest it later yield back its foulness to the purified metal. In the narrow ring of which the melting chamber of the Kjellin furnace consists, the removal of the slag is so difficult that the furnace is ill suited for purification, and it is no doubt this fact that has given rise to the current idea that it is impossible to purify in the induction furnaces. This may be true of the Kjellin furnace, but it is clearly absolutely untrue of the Roechling-Rodenhauser furnace. I have before me the analyses of 17 consecutive heats made in one of these furnaces in which the initial phosphorus content of from 0.035 to 0.085 per cent. was reduced—

In 12 heats to traces
" 4 " " 0.01 per cent., or less
" 1 " " 0.012 per cent.

The phosphorus was reduced to traces in seven consecutive heats. In another set of 25 consecutive heats the sulphur was reduced from between 0.048 and 0.097 per cent.—

In 15 heats to traces
" 3 " " less than .02 per cent.
" 7 " " between 0.02 and 0.032 per cent.

One would naturally fear that the narrow channels of this furnace would be likely to entrap part of the slag; but these excellent results lead us to believe that this is not necessarily true when the conditions are favorable. Thus, if this furnace is really under any disadvantage in this respect, it can only be that it has less perfect control over the purification than arc furnaces have.

Neither of these induction furnaces seems well suited for melting down cold charges, because it is only in a molten charge that the current is readily induced. The Roechling-Rodenhauser furnace seems to be further unfitted for the work of melting cold charges by the apparent vulnerability of its internal walls surrounding the cores. One naturally fears that, after these walls have become brittle through repeated heatings and coolings, the workmen will be very likely to damage them in charging cold scrap in irregularly shaped pieces. But to this objection I attach little weight. I do not think that any electric furnace should be used for melting down, because this work can be done so much more cheaply in a cupola or open-hearth furnace.

Beyond this the cost of installation and probably that of repairs is greater, and the consumption of electricity rather less in the Roechling-Rodenhauser than in the arc furnaces.

Another feature of the induction furnaces, the effect of which remains to be examined with care, is the rapid rotation of the molten metal, brought about by the action of current. How is this swift movement going to affect the removal of the suspended matter, slag, etc., from the molten metal? This, I think, must depend on the fluidity and cohesiveness of that matter. If it is dry and non-coherent, then its removal must be brought about by giving it a chance to rise slowly to

the surface by gravity, and such a slow separation is opposed by this rapid motion of the metal, quite as the clearing of roily water would be by stirring it up, or the settling of dust would be by a high wind. But if the suspended matter is sticky, then this motion may assist its removal just as churning hastens the separation of butter, by helping it mechanically to coalesce into particles large enough to swim upward strongly.

The solution of this trouble would seem to be: (1) to give the suspended matter such composition as to make it sticky; (2) to put the bath into motion, as by poling or by the circulation which occurs in these induction furnaces, so as to aid mechanically the process of coalescing; and (3) to give quiet at last, so that the particles which thus have coalesced may rise to the surface.

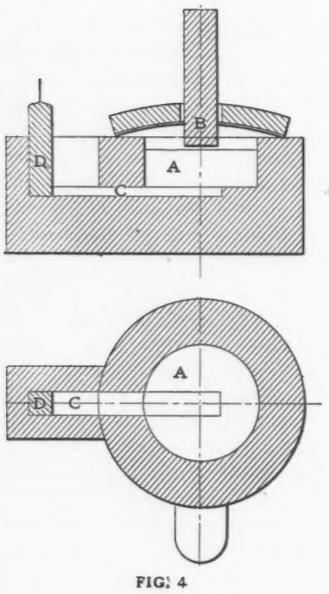


FIG. 4

FIG. 4. GIFFRE FURNACE

A, molten steel. *B*, upper electrode. *C*, solid steel connecting with lower electrode. *D*, lower electrode.

Comparison of Furnaces

To sum this comparison up, if these furnaces are used for their normal work of completing the purification begun in the open-hearth furnace or bessemer converter, there really seems but little to choose between them, if we except the Kjellin furnace, the usefulness of which seems very limited. The electrode furnaces have their electrode troubles, which are likely to be at their worst in the Stassano furnace. In the other electrode furnaces this trouble seems now to have been reduced within reasonable limits. There remain the cost of the electrodes, always a serious item, the possibility that the high heating opposite the arc may cause some permanent injury to the metal, and probably a slightly greater consumption of electricity than in the Roechling-Rodenhauser furnace. Against these slight disadvantages of the arc furnaces are to be weighed their probably somewhat better control over the purification in case the highest purity is aimed at; their smaller cost for installation and repairs; and perhaps their more complete removal of suspended matter because of the quiescence of their metal. Really, there seems but little to choose.

If cold charges are to be melted, the induction furnaces seem out of the race, and the violent oscillations of the current in the Stassano and Heroult furnaces would rather turn one's choice toward the Giffre or the Girod furnace.

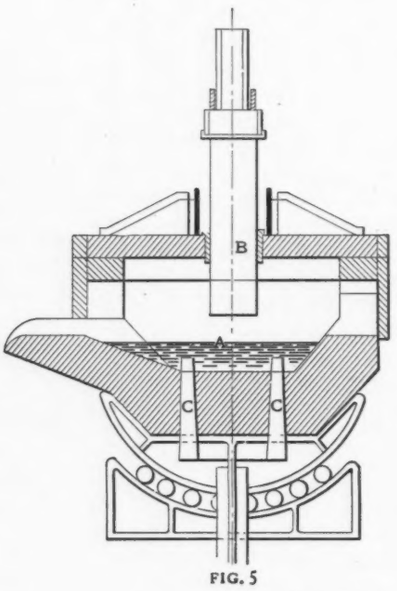


FIG. 5

FIG. 5. GIROD FURNACE

A, molten metal. *B*, upper electrode. *C*, lower electrode.

Discussion

We are now in a position to take up the discussion of the metallurgical principles which underlie the various purification processes, whether the furnaces in which they are carried out are heated by electricity or by other means. Indeed, the main purpose of this present article is to add, if possible, to the already clarifying effect of Mr. Coussergues' work.

The discussion may be divided into that concerning the oxidizing stage of the process in which phosphorus is removed by means of iron oxide; and the deoxidizing stage in which sulphur and iron oxide are removed, together with suspended solid matter, and probably also together with hydrogen and nitrogen. The removal of the iron oxide may be begun by means of the usual reagents, carbon, ferro-silicon, aluminum, etc.; it is completed together with that of the sulphur by means of calcium formed in the process itself.

Dephosphorization

Mr. Coussergues remarks that the chemical composition of slags does not in and by itself give a fair basis for dividing them into those which do and those which do not dephosphorize,[2] because whether dephosphorization shall occur depends on other conditions in addition to the composition of the slag. A slag which will absorb phosphorus from an oxidized bath will not absorb it from an unoxidized one. Now, while it is perfectly true that whether dephosphorization shall or shall not occur depends upon the balance of several opposing forces, yet I wish to point out that we can simplify the matter considerably by discriminating between slags which actively dephosphorize and those which are simply retentive of phosphorus, or in short into the dephosphorizing and the nondephosphorizing on one hand, and the retentive

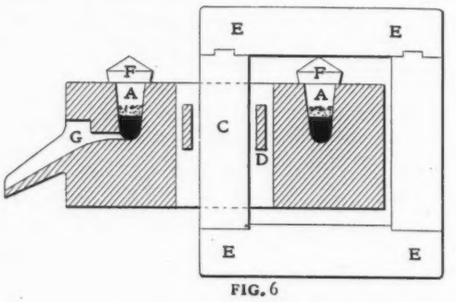


FIG. 6

FIG. 6. KJELLIN INDUCTION FURNACE

A A, circular trough in which steel is melted and treated. *C*, magnetic core. *D*, primary coil. *E*, frame connecting ends of *C*. *F*, cover for melting chamber. *G*, spout.

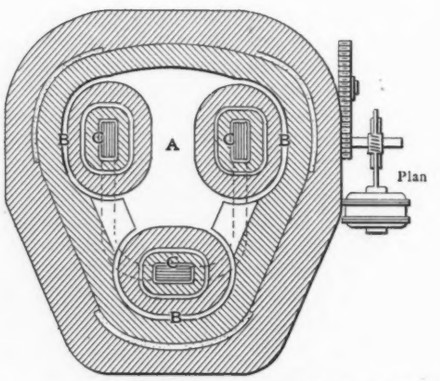


FIG. 7 *The Engineering & Mining Journal, N.Y.*

FIG. 7. ROECHLING-RODENHAUSER INDUCTION FURNACE

A, basin for molten steel. *B*, three narrow channels in which the steel lies. *C*, three cores and coils for inducing current in the steel.

[2] *Revue de Metallurgie*, June, 1909, p. 641.

and the irretentive on the other. Phosphorus cannot in general be removed except by oxidizing it. Hence a very basic lime silicate without iron oxide, made fusible by means of fluorspar, cannot appropriately be called dephosphorizing, because it has no strong power of oxidizing the phosphorus; yet it may be very retentive of phosphorus, so that if phosphorus is oxidized in presence of such a slag, it will be removed from the metal permanently.

It is from this point of view that I have said that silicates and phosphates of iron are more dephosphorizing for like basicity than those of lime. Those of iron play the double part of carrying oxygen from the atmosphere to the phosphorus, or, if put to it, of giving up their own oxygen to that phosphorus, which lime cannot do, and also of retaining through their basicity the resultant phosphori acid. Mr. Coussergues cites [3]one effective way in which the ferruginous slags do this, by impregnating the metallic iron itself with iron oxide, and thus placing this oxide most advantageously for oxidizing the phosphorus dissolved alongside it in the iron, and therefore exposed to it, ion to ion. But this is only one feature of the oxidizing power of ferruginous slags which gives them their advantage over the calcareous ones. The ferruginous slags are strong both in oxidizing phosphorus and in retaining the resultant phosphoric acid; the calcareous ones are strong only in retaining the phosphoric acid which some other agency has formed.

Mr. Coussergues properly points out the need of a formula[4] for expressing the relation between the several conditions, including the composition of the slag, and the strength of the dephosphorizing action to which they lead, and says reasonably that such a formula is likely to be based on the law of maximum work. For instance, the ratio between the phosphorus which enters the slag and that retained by the metal is likely to depend upon the heat generated by the formation of the phosphate, and the absorption or evolution of heat caused by the simultaneous reduction of the basicity of the slag. To this I would add that the law of mass action is likely to have a very important effect. I am sometimes tempted to call this the railroad-lunch-counter law. Here is a lunch counter spread with various things. Some of these we like much, some we like but little, some we barely tolerate, others we almost abhor. If the counter is not crowded, I select solely those things which I like best; if it is crowded enough, if I am hungry enough, and if the train is to start soon enough, I may be forced to eat those things least attractive to me, if the attractive viands are scarce and hidden behind masses of less tempting ones. So with my neighbors, and so with the processes of oxidation, reduction and the rest. If the oxygen comes upon the scene but slowly, it may select almost rigidly the most attractive element, i.e., it may form almost solely the combination which will yield the most heat. But let it rush through, and like a rough crowd at a lunch table, many molecules will snatch what they can get in their hurried passage, even if it is relatively unattractive, i.e., if the combination yields relatively little heat. This mental picture often helps.

[3]*Revue de Metallurgie*, June, 1909, p. 647.
[4]*Revue de Metallurgie*, June, 1909, p. 643.

The Oxidizing Period

Mr. Coussergues points out that this hardly differs materially from the corresponding period of the basic open-hearth process, unless it is in the fact that that fear of over-oxidizing the metal which is ever before the open-hearth melter, basic or acid, does not trouble the electric-furnace melter, for the simple reason that, in the following deoxidizing period, the deoxidizing conditions are so strong that he can undo any degree of over-oxidation, no matter how great. Hence the electric-furnace melter can push his dephosphorization, by rapid oreing, as the open-hearth melter cannot.

But we have to be guarded even in going as far as Mr. Coussergues does in favor of the electric furnace. The electric furnace slag richest in iron which he cites, contains only 56.36 per cent. of the combined oxides of iron and manganese (metallic oxides for short), which is not appreciably more than the reaction slags of the Monell open-hearth process contain at times without danger of over-oxidation of the metal. The difference between the two cases is that the metal which accompanied this electric-furnace slag had but little carbon, 0.05 per cent.; whereas that in the Monell process is much richer in carbon. Therefore, to speak accurately, if the metal is low in carbon the electric furnace enables us to ore more rapidly than we could in the open-hearth furnace; but I see no reason to think that it has any advantage even in this respect in case the metal is relatively rich in carbon, for then the rate of oreing is limited only by the resultant frothing. At best this advantage can hardly compensate for the much greater cost of the electric treatment.

In order to remove a large quantity of phosphorus, as for instance in making low-phosphorus steel from materials rich in phosphorus, several successive slags should be used. Here again as in the Monell process the first slag may be made rich in iron, so that it will take out the great bulk of the phosphorus, and may then be resmelted in the blast furnace, though, of course, if this were done on a large scale, it would continuously increase the phosphorus content of the pig iron, a trouble which hangs over the Monell process. The final dephosphorizing slag, once the metal itself is well charged with oxygen, may be relatively poor in iron and rich in lime. But here again it is not easy to see what advantage the electric furnace has over the open hearth.

As I have already pointed out, it is hard to see why it is worth while to use an electric furnace for dephosphorizing, because the basic open hearth does this same work so cheaply, and can be made to do it so thoroughly. The great accent that has been put on the possibility of making excellent steel in the electric furnace out of bad scrap seems, as far as phosphorus is concerned, very misleading. In short the reason for the existence of the dephosphorizing stage of the electric-furnace process has yet to be shown.

Deoxidizing and Desulphurizing

It is in this part of the process that the great interest lies; here, indeed, the formation of calcium sulphide introduces something of a new departure in steel metallurgy proper, and enables us to push the desulphurizing much farther than has been possible hitherto. For instance, with the best selected coal, the skilful French open-hearth men have not been able to reduce the sulphur below 0.02 per cent. In this country it has been found hard to reduce it to 0.025 per cent., and 0.03 per cent. is about as low as is attainable in common work, so fast is sulphur taken up from the flame. But in the electric furnace by forming calcium sulphide the sulphur can be reduced to mere traces. As to the importance of this reduction from 0.025 per cent. to traces, I shall have something to say later on.

If there has been an oxidizing stage, the first step after it is to remove with great care the phosphoric slag then formed, lest its phosphorus be deoxidized in the deoxidizing stage, and thus returned to the bath. For instance, in the electrode furnaces the electrodes may be withdrawn, and the slag thickened with lime or otherwise, so that it may be skimmed out completely.

Next comes the rough deoxidizing, brought about very much as in bessemer and open-hearth practice, by additions of carbon, silicon, manganese, or aluminum. As Mr. Coussergues points out, carbon should be used for removing the first of the oxygen, and the more expensive reagents should be used only for the last of it. He seems to think that carbon is intrinsically unable to finish the deoxidizing, and cites the large quantity of oxygen, at times enough to cause redshortness, that remains in steel recarburized by the Darby process, in which the oxidized products, the blown metal of the bessemer process, and the ored metal of the open-hearth process, are recarburized by bringing them into contact with solid

carbon. But the fact that the very brief contact of the Darby process leaves much oxygen in the metal does not necessarily prove that prolonged contact with carbon, such as can be had in the electric furnace, is incompetent to remove the whole of the oxygen. There are inded special circumstances under which carbon cannot be used, for instance in the Kjellin furnace, in which the upper surface of the slag may be so viscid that carbon cannot act upon it. In that case the fusible ferrosilicon, thrown on in pea-sized lumps, melts and finds chinks through which it can work down. In the use of the Roechling-Rodenhauser furnace, as I understand, this difficulty can be got over if necessary by breaking through the crust of slag in its large basin.

But in the electrode furnaces the action of carbon, thrown upon the metal, or upon the very basic slag now formed by adding lime, or lime and sand, can be prolonged. Now if, as seems clear, carbon can reduce lime by the reaction

(1) $C + (FeMn)\ S + CaO = CaS + FeMn + CO$,

it is hard to understand why that same carbon cannot deoxidize iron oxide completely.

The natural mechanism of this deoxidation is that the oxides of iron and manganese start to distribute themselves between metal and slag according to the coefficient of distribution corresponding to the existing conditions, such as temperature and composition of slag and of metal; and that the retort carbon or other form of carbon thrown upon the molten slag reduces the oxides of iron and manganese which have entered that slag, thus opening the door for the entry of other lots of those oxides.

An alternative way would be to begin the deoxidation with pure Swedish pig iron, which should work very quickly, and to follow it up with carbon.

Desulphurizing

After the deoxidizing is nearly complete, comes the desulphurizing by reaction (1) just given, and probably, in case ferrosilicon is used, by the similar one

(2) $2\ (FeMn)\ S + 2\ CaO + Si = 2\ CaS + 2\ (FeMn) + Si\ O_2$.

Clearly neither of these reactions should occur as long as any important quantity of oxide of either iron or manganese remains, because such oxide would yield its oxygen to the carbon or silicon far more readily than the lime would. In point of fact the Remscheid engineers maintain that the slag should not contain more than 1 per cent. of the oxides of iron and manganese jointly.

Desulphurizing by Distribution

These sulphides of iron and manganese tend to pass into the slag, i.e., to distribute themselves thus between metal and slag, in a ratio called the "coefficient of distribution," which varies with the attendant conditions. It has been held that in a general way this coefficient increases with the temperature and with the percentage of lime in the slag, and decreases with the percentage of iron oxide in the slag. In other words, the higher the temperature, and the more lime and the less iron oxide the slag contains, the greater will the sulphur content of the slag be and the less will that of the metal be when the sulphur shall have distributed itself according to the then existing coefficient of distribution. Sulphur thus brought into the slag may escape thence by burning to sulphurous acid at its surface.

In view of this, the presence of metallic oxides (oxides of iron and manganese), of course, does not prevent sulphur from passing into the slag in the form of sulphide of iron or of manganese. Thus, one of the slags which Mr. Coussergues gives contains 6.35 per cent. of ferrous oxide and 11.16 per cent. of manganous oxide, or together 17.51 per cent., yet it has also 0.21 per cent. of sulphur. But, while the first of the sulphur can thus be slagged by "distribution," it is very slow work to reduce the sulphur to below 0.02 per cent. in this way. If, under favorable conditions, the coefficient of distribution rises to 5, so that the passage of sulphur from metal to slag might theoretically go on till the percentage of sulphur of the latter was five times as great as that of the former, then starting, say with 0.05 per cent. of sulphur and with a slag weighing one-fifth as much as the metal, the slagging of sulphur would cease when the sulphur content of metal and slag respectively had reached 0.025 per cent. and 0.125 per cent Moreover, this slagging would grow extremely slow as this limit was approached, so that before reaching it the slag should be withdrawn and replaced with a fresh one. If this was done when the metal still contained 0.035 per cent. of sulphur, then the lowest point to which the sulphur could theoretically be reduced by this fresh slag would be 0.0175 per cent., and so on. Thus the removal of the last of the sulphur goes on ever more and more slowly.

But, if the slag and metal are so free from oxides of iron and manganese that lime can be deoxidized and calcium sulphide formed, then the desulphurization is rapid and may be made complete, because the resultant calcium sulphide, instead of merely distributing itself between metal and slag in a limited ratio, seems to pass wholly into the slag, or if not absolutely wholly, then at least in a very much greater proportion than the sulphides of iron and manganese do. Thus one of the Völkingen slags quoted by Mr. Coussergues contains 125 times as much sulphur as the underlying metal. The sulphur content of the slag is 2 per cent. that of the metal, 0.016 per cent.

The symptoms by which the formation of calcium sulphide is recognized are (1) that the slag becomes snow white, and (2) that it falls to powder in cooling. Both these things are evidence that the slag contains no important quantity of the oxides of iron and manganese, but the slacking does not prove that the lime content is very high, as is often thought. As the presence of these oxides is the only obstacle to the formation of calcium sulphide and the thorough removal of the sulphur, these signs of their absence are accepted as proving that this strong desulphurizing has begun. But, as we wish not simply to begin but to complete it, the desulphurizing action should be prolonged for say 45 min. after these symptoms have become marked. During this time the consumption of electricity should be hardly more than that needed to make up for the losses by radiation, because the temperature remains practically stationary, and because no important endothermic chemical change occurs.

It is asserted that the carbon thrown upon the slag for forming the calcium sulphide has no important effect in carburizing the metal.

Is Extreme Basicity Needed for Desulphurization?

In the iron blast furnace basicity of slag certainly favors desulphurization, but even here the basicity should be held within such bounds that the slag remains fluid enough to change quickly its surface of contact with the iron, the place where desulphurization occurs. In the basic open-hearth furnace, too, the slag is habitually kept as basic as possible, by adding lime just fast enough to keep some lumps of it unabsorbed and protruding above the molten slag. And certainly it is true that, if lime is to be reduced, it should not be held too tenaciously by the silica, and plenty of it should be exposed to the carbon which is to reduce it, two ways of saying that the slag should have plenty of lime. Again, as already pointed out, there is good reason to believe that the coefficient of distribution of manganese sulphide, i.e., the ratio of the sulphur content of the slag to that of the metal, increases with the lime content of the slag.

But inferences from these facts should be drawn cautiously. In the first place, what would be very calcareous for a blast-furnace slag would not be for a basic open-hearth or electric-furnace slag. In the second place, the crowding of lime into the common open-hearth slag is rather for dephosphorizing than for desulphurizing. In the third place, though richness in lime may favor the

passage of manganese sulphide into the slag, it does not at all follow that it strongly favors the formation of calcium sulphide. In short, the conditions in the electric furnace are so unlike those of the blast furnace, and the mode of removal of sulphur is so radically different from that of the basic open hearth, that the experience with those furnaces is not a good guide for the electric furnace.

Turning now to the data which Mr. Coussergues gives, we find not only that the sulphur content of the slags bears no relation whatsoever to their basicity, but that the least basic but one, with only 2.08 molecules of base per molecule of acid, i.e., barely a bibasic silicate (singulo-silicate), has as much as 1.06 per cent. of sulphur.

I rearrange his data as shown in Table 1.

Though it is noteworthy that the only one of these which is less than bibasic, with a molecular ratio of base to acid of only 1.56, contains very little sulphur, only 0.04 per cent., yet we must set against this the fact that blast-furnace slags which are much less basic may yet contain much sulphur. In two cases given by Mr. Coussergues the ratio of the molecules of base to those of acid was 1.437 and 1.60,[5] yet the sulphur content was 3.90 per cent. in the first and 2.56 in the second.

TABLE 1. DESULPHURIZATION DOES NOT DEMAND GREAT BASICITY OF SLAG.

Ratio of molecules of basic to those of acid...	5.083	3.925	3.667	3.572	3.429	2.828	2.472	2.154	2.081	1.56
Sulphur content of slag.....	0.75	1.48	1.47	0.06	2.00	0.21	0.44	1.26	1.06	0.04

In Table 2 I give several blast-furnace slags which contain a considerable quantity of sulphur, in spite of having much less lime and magnesia than basic open-hearth slags do. Thus, it may be found practicable to desulphurize in the electric furnace without recourse to strongly basic slags; indeed, one does not see at first any difference in conditions between the blast furnace and the electric furnace competent to prevent the very moderately basic slags which can desulphurize in the former from doing like work in the latter. The desulphurizing slags in both cases are almost free from oxides of iron and manganese; the temperatures are not far apart; and the actual contact between carbon and slag is common to them, and need not be limited in extent in the electric furnace, so far as one can see.

The observation at Völklingen that an accidental addition of sand which thinned the slag and was followed by a strong smell of sulphurous acid, increased the desulphurization so that only 0.04 per cent. of sulphur remained,[6] is interesting, and deserves a certain weight. But its importance is easily overrated, because, while we will all admit that such extreme basicity as makes the slag so viscid that its surface of contact with the bath does not quickly renew itself, is harmful, yet what we are now considering is the effect of basicity within the limits of good fluidity, on the removal of sulphur as calcium sulphide. It is very doubtful whether any such removal occurred in this particular case, because desulphurization by distribution, through the action of manganese sulphide, could easily reduce the sulphur to the percentage, 0.04 per cent. here reached.

Influence of Manganese on Desulphurization

The belief of some metallurgists that manganese hastens desulphurization has been opposed with evidence which, as Mr. Coussergues says, seems quite incompetent.[7]

The defect in the evidence is that in those of its cases in which the desulphurization was incomplete in spite of the presence of manganese, the slags themselves contained enough oxide of iron and manganese jointly to prevent desulphurization. In order to understand this we must bear in mind the true role of manganese which I have already explained. Its direct action seems to be confined to carrying sulphur into the slag by distribution in the form of MnS. As already pointed out, though it may in this way remove the first of the sulphur readily, it can remove the last only slowly. Certainly we cannot expect it to go beyond this desulphurizing by distribution, and actually lead to the formation of calcium sulphide and thereby to rapid and complete desulphurization, simply because we cannot expect it to deoxidize lime, a thing, of course, absolutely necessary to the formation of calcium sulphide. In the presence of sulphide of iron or manganese, lime can be deoxidized by carbon, silicon, and probably by aluminum and by silicide of calcium, but neither by iron nor manganese.

But manganese may hasten the formation of calcium sulphide in a very simple and effective way. It seems perfectly clear that manganese oxide and sulphide pass from metal to slag far more rapidly than iron oxide and sulphide do.

Indeed, one is often tempted to give it as a general law that the metals retain their own oxides and sulphides far more strongly than they retain those of other metals. Now carbon and lime can do their work of desulphurizing by reaction (1) only as fast as these metallic sulphides are brought before them in the slag, and only on the condition that the whole mill is not thrown out of gear by the presence of oxide of iron or of manganese in that slag. The presence of manganese certainly hastens the removal of iron oxide by carrying its oxygen from the metal to the deoxidizing action of the carbon floating on the

TABLE 2. SULPHUR IN BLAST FURNACE SLAGS NOT STRONGLY BASIC.

No.	CaS.	S.	SiO_2.	Al_2O_3.	CaO.	MgO.	Reference.
1.	0.38	0.17	66.90	14.08	12.24	4.48	W. Matheisus, *Stahl und Eisen*, 28, pp. 1122-1125; Aug. 5, 1908; also *Revue de Metallurgie*, Extraits, 6, pp. 144-147, March, 1909.
2.	4.75	0.78	47.94	12.01	31.20	4.36	
3.	2.10	0.93	45.57	7.35	33.20	6.13	
4.	4.39	1.95	27.65	24.69	36.56	3.55	
5.	7.76	3.44	33.10	24.56	25.92	6.97	
6.	....	0.24	42.15	11.02	43.00	1.25	R. H. Sweetser, *The Iron Age*, 82, p. 446, Aug. 13, 1908.
7.	....	1.23	35.00	11.17	46.40	4.68	My private notes.
8.	2.17	0.96	35.20	10.02	47.10	1.20	Jantzen, *Stahl und Eisen*, 23, p. 362, March 15, 1903.
9.	....	0.08	49.57	9.00	.....	15.15	H. H. Campbell, "The Manufacture and Properties of Iron and Steel," 2d. Ed. (1903), p. 52.
10.	....	0.08	48.39	6.66	.....	10.23	

[5] Mr. Coussergues gives this as 0.889, but I calculate it as 1.60.

[6] Professor Osann, *Stahl und Eisen*, XVIII, July 15, 1908, p. 1018.

[7] Professor Osann gives the results of two heats in the Roechling-Rodenhauser furnace at Völklingen, in which additions of ferromanganese so large as to put 0.96 and 0.64 per cent. of manganese into the metal, yet left 0.053 and 0.044 per cent. of sulphur in the slag (*Stahl und Eisen*, XXVIII, July 15, 1908, pp. 1019 to 1021). But these additions of ferromanganese were made immediately after the end of the oxidizing period, when the metal was sure to have been charged with oxygen, and the slag was sure to have contained much oxide of iron and manganese jointly. For the first of these heats the composition of the slag at that time is not given; but its final slag contained 8.12 per cent. of oxides of iron and manganese, in spite of the addition of ferrosilicon meanwhile; and the final slag of the other heat contained 11.30 per cent. of iron oxide and 5.88 per cent. of total manganese (not manganese oxide), or say more than 18 per cent. of oxides of iron and manganese jointly. No wonder that the sulphur was not fully removed under these conditions.

slag, and thus gradually slides the mill into gear; and it hastens the movement of grist to the mill by hastening the transfer of sulphur as manganese sulphide from metal to slag. Evidence that manganese does not cause immediate desulphurization of slags which are rich in oxide of iron or manganese only shows us what should not surprise us, that the wagon which brings grist to the mill cannot by itself jerk the mill into gear.

Influence of Temperature on Desulphurization

The opinion of many electric-furnace metallurgists that low temperature favors deoxidation and desulphurization does not really conflict with the well established fact that a high temperature in the blast furnace favors desulphurization by the formation of calcium sulphide, because in the blast furnace it may not be the high temperature as such, but the attendant conditions that are responsible. One of these conditions, as Mr. Coussergues point out, is absence of metallic oxides from the slag; a second is the presence of silicon in the molten iron, which at the junction of slag and metal may well co-operate with the lime of the slag to desulphurize by reaction (1).

But further evidence is needed. If, as seems very probable, high temperature favors the retention of iron oxide by the metal, by increasing its solubility in the metal or otherwise, that in itself would retard the freeing of the metal and slag jointly from metallic oxides in the electric furnace, and in this way would lengthen the operations of deoxidizing and desulphurizing taken together. With our present knowledge it is not so easy to discriminate between the effects produced on these two essentially distinct phases by variations in the attendant conditions such as temperature.

If it is really true that deoxidation and desulphurization taken jointly are favored by a low temperature, that may well be one reason why they are not favored by strong basicity of slag, because a very basic slag needs a high temperature to keep it fluid enough for active work.

Removal of Hydrogen and Nitrogen

Electric-furnace steels examined by Guillet contained less nitrogen and especially less hydrogen not only than open-hearth steel, which is natural enough in view of the exposure of the latter to the atmosphere in the open-hearth furnace, but also than crucible steel, which is rather surprising. Mr. Coussergues reasonably suggests that the relative freedom from hydrogen may be due to the formation of acetylene or other hydrocarbon at the surface of contact of metal and slag by the reactions

$Ca + 2C = CaC_2$, and $CaC_2 + 2H = Ca + C_2H_2$.

Letting the Cream Rise

The conditions in the electric furnace may well lead to a more thorough separation of the slag and like suspended solid matter than is possible in the open-hearth process. Here the deoxidizing additions are made at the very end of the operation, just before the metal is tapped out of the furnace, or, as is too often the case, as the metal runs from furnace to ladle, so as to avoid any long exposure to the necessarily oxidizing conditions, which partly undoes the work of deoxidation and so increases the consumption of deoxidizers. But each of these deoxidizing additions gives rise to a harmful product, carbon to carbonic oxide which may form blowholes, manganese to manganous oxide which may later form them by reacting on the carbon of the metal, and silicon and aluminum to silica and alumina in a very fine state of division. Though we have not worked out thoroughly the conditions necessary for freeing the metal from these suspended substances and from dissolved carbonic oxide, there is probably good ground for the complaint that "we make too much steel in the ladle," i.e., that we do not give time enough for letting these harmful products of our deoxidizing rise to the surface and escape into the slag or the atmosphere.

Now note what advantages the electric furnace, with its strongly deoxidizing conditions, has in this matter over the open-hearth furnace with its strongly oxidizing atmosphere.

(1) Because the metal is thoroughly deoxidized by carbon thrown upon the slag, the final additions have very much less deoxidation to do and hence the quantity of harmful products of that deoxidation is very much smaller than in the open-hearth process, indeed hardly more than what is implied by the slight oxidation in passing from furnace to mold.

(2) The absence of oxidizing conditions leaves the metal in the electric furnace quiescent, with the best possible opportunity for any suspended matter to rise by gravity and escape from the metal, whereas in the open-hearth furnace the oxidizing atmosphere, ever generating iron oxide which forms carbonic oxide with the carbon of the steel, keeps the bath in a boil which, even if it is relatively slight, may be expected to oppose the separation of suspended matter. But here we must speak guardedly, for the reasons pointed out, in comparing the electrode and the induction furnaces with regard to the removal of suspended matter.

(3) In the electric furnace the absence of oxidizing conditions enables us to hold the molten charge long after the deoxidizing additions, in order to enable the suspended matter to separate, without fear of rapid change of composition, whereas the oxidizing conditions in the open-hearth furnace bring about such rapid changes of composition that only the most skilful can hold the charge in the furnace long after making the final additions without great and indeterminate changes in composition. In the open-hearth furnace our game is on the wing; in the electric furnace it is on the bough.

Mr. Coussergues thinks that the greater time available in the electric furnace for the separation of suspended matter by gravity is of little value, because this separation is in any event so rapid. If he has good evidence to prove this it will be welcome. The large quantity of slag which we so often find in our steel hardly prepares us for this belief. Certainly our natural expectation is that this extremely finely divided matter, which, as we find it in the sides of the pipe is an impalpable powder, should be very slow in rising, if we may reason from the time which cream takes to rise from milk and roily water takes to clear itself.

Summary

Looking back, we see that, as an instrument for melting and dephosphorizing, the electric furnace has no advantage over the cupola and open hearth, certainly none which can compensate for the great cost of its heat. It is in its thorough deoxidizing and consequent thorough desulphurizing, its removal of suspended matter, and probably of hydrogen, that the electric furnace is at an advantage.

Looking a little closer one naturally asks whether the reduction of sulphur and phosphorus from 0.025 per cent. to any smaller quantity is, in and by itself, enough either to pay for the great cost of the electric treatment or to make the steel materially fitter for any but the most trying uses. We are rather inclined to refer a very large part of the superiority of electric steel to open-hearth steel to its greater freedom from oxide, from suspended slag, and perhaps from hydrogen and nitrogen. But whatever its elements of superiority may be, it seems pretty clear that they are directly or indirectly the result of the strong deoxidizing conditions in the deoxidizing and desulphurizing part of the process, in short, to the freedom of its atmosphere from oxygen.

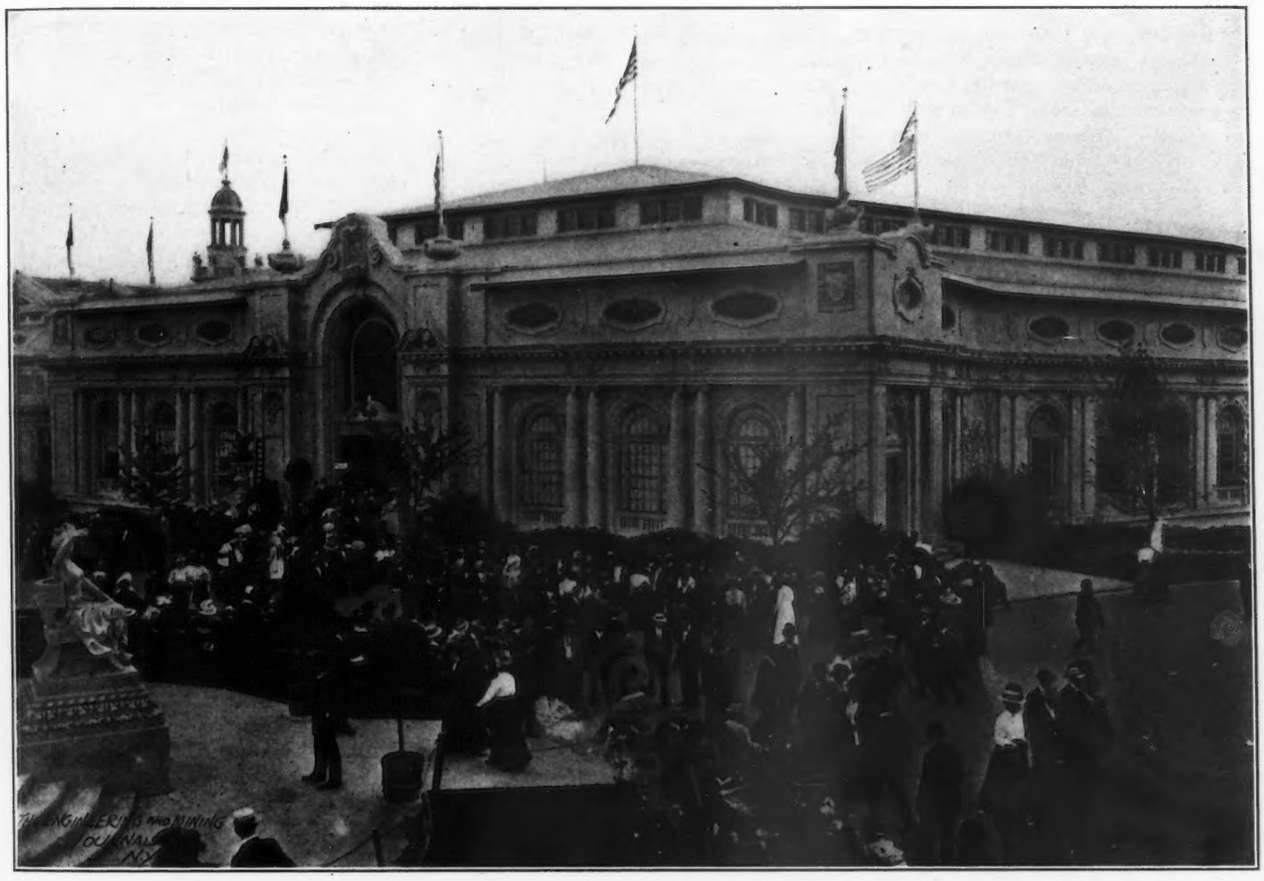
One of the oldest pumping engines in existence is still in service at the old Dolcoath tin mine in Cornwall. It was installed in 1815.

Alaskan Mineral Exhibit at A-Y-P Exposition

Wealth and Advantages of Alaska Displayed; $500,000 in Gold Exhibit. History of Mining Outlined and Recent Developments Shown

BY E. JACOBS

As the primary object of the Alaska-Yukon-Pacific exposition, now being held at Seattle, Wash., is to exploit the natural resources of Alaska, exhibits from that country properly form a prominent feature. The whole of the extensive and comprehensive exhibition in the Alaska building has been in charge of four heads of departments, all under J. C. McBride, commissioner for Alaska, who so assiduously furthered the efforts of his executive officials that, when the hour fixed for the formal opening of the exposition arrived, everything was ready—save only the placing in its booth of the placer-gold exhibit, which the insuring company would not permit until after some changes, deemed desirable for safety, had been made in the electric-light wiring.



THE ALASKA BUILDING

The mineral department, the most important in the Alaskan exhibit, is in charge of John D. Fields, mining engineer, of New York, who is familiar with the mineral resources of Alaska and their development, and who has succeeded in collecting ample material for a thoroughly representative and effective display. The main purpose kept in view throughout, in organizing and arranging this department, has been to show results thus far obtained from money expended and labor performed in developing the mineral resources of Alaska. Special efforts have been made to overcome the generally prevailing idea that Alaska is a land of perpetual ice and snow, and to do this agricultural products from Alaska have been, and are still being obtained and exhibited, together with many enlightening photographs of the country as it appears during the part of the year—about six months—when it is not covered by snow.

History of Mining in Alaska

From "Mining and Mineral Wealth of Alaska" (repeatedly drawn upon in preparing this article), it is learned that probably the earliest exploitation of any mineral deposit in what is now Alaska was the recovery of copper nuggets by the aborigines from the stream gravels of Copper and White rivers. Bering, the discoverer of Alaska, when he made his first landing on Kayak island in 1741, observed that the natives had copper knives, and later explorers reported a wide distribution of copper utensils among the indigenous inhabitants of the Territory.

American prospectors went to Alaska in 1867, soon after the transfer of Russian America to the United States and, in 1869, found placer gold at Sumdum bay, southeastern Alaska. Gold-bearing quartz veins were first discovered in 1877,

near Sitka, and a small stamp mill was erected there in 1879.

The systematic development of copper ore deposits was commenced in 1899, both on Prince of Wales Island and Prince William sound. From 1898 on, the basins of Copper and White rivers were much prospected for copper ores.

Placer tin was first found near York, Seward peninsula, in 1900, and stream tin was produced in commercial quantity in 1902. Lode tin was discovered in 1903 since which year there has been a small output of this mineral.

The first commercial mining of coal was on Admiralty island in 1880, followed in 1888 by the opening of a mine on Cook inlet. In 1895 coal mining was attempted on the Yukon, and in the same year the high-grade coals of the Bering river field, near Controller bay, began to attract attention, though it was not until about 10 years later that systematic prospecting of these coal measures was begun. The Matanuska bituminous coalfield was being prospected in 1898. Similar coal has been found on Bering lake, and a small production was made here in 1907. Coal is also known to occur in many other parts of Alaska, but coal mining is as yet only a small industry. Statistics show the largest annual production to have been 53,600 tons, practically all lignite, in 1907.

Petroleum seepages in Alaska were probably known during Russian occupation of the country. The first drilling for oil was done at Controller bay in 1901, and the following year similar work was carried out at Cook inlet.

The quarrying of marble, for tombstones, was commenced in southeastern Alaska late in the nineties, but operations were limited prior to 1904, in which year they were considerably extended. A deposit of gypsum was opened on Chichagof island in 1904, since which year there has been an increase in output annually.

U. S. Geological Survey Exhibit

The U. S. Geological Survey has made at the Alaska-Yukon-Pacific exposition what may be regarded as a scientific exhibit, chiefly for the benefit of technical men and students, though it is also decidedly instructive to the general public. It shows, by reports, geologic and topographic maps, etc., as well as by mineral collections, the results of the work of the Survey in Alaska and how they had been brought about. It includes district and locality maps, photographs, transparencies, rocks, ores, and placer gold. The whole exhibit forms a comprehensive study of the geology and mineralogy of Alaska, and its object and effect are distinctly educational. It is arranged in sections and in them are placed on tables a number of the Survey reports on Alaska, for convenient reference and study by those interested in the subjects illustrated by the exhibits.

The rocks and minerals on exhibition include every known species yet found in Alaska, all named and systematically arranged in glass-covered cases. Among the metalliferous minerals there is much native copper, while in the exhibit of placer gold there is a sample from every Alaskan creek known to have yielded gold.

The fuels shown include peat; coal, lignite, bituminous and anthracite; natural and artificial coke; and crude oil.

The usefulness of this comprehensive and generally excellent exhibit is enlarged by a 46-page pamphlet containing a fairly full summary of facts and figures relating to the "Mining and Mineral Wealth of Alaska," prepared by Alfred H. Brooks, geologist in charge, Division of Alaskan Mineral Resources, U. S. Gelogical Survey, and published by the Department of the Interior for distribution in connection with the Alaskan exhibit.

Commercial Mining Exhibits

The numerous exhibits in this section show commercial mining in each of six divisions for districts of Alaska, namely; Seward peninsula, Fairbanks and Tanana, Juneau, Ketchikan, Valdez, and Katalla, the last-mentioned being chiefly a coal division. The samples of ore and other mineral products are from all the principal mines in each of these divisions It is noteworthy that few districts possess so large a variety of minerals, both rare and common, as does the Nome or Seward peninsula district; gold, silver, lead, copper, tin, iron, bismuth, antimony, nickel, cinnabar, molybdenum, scheelite coal, graphite, jade, asbestos, mica, etc., occurring on it. Many of the exhibits of ores and coal have been arranged in pyramidal form, thus facilitating examination.

Placer Gold and Copper

More than three-fourths of the value of Alaska's mineral production, which in four years, 1905-1908, totaled nearly $81,000,000, having been in placer gold, especial prominence has been given to exhibits in connection with that class of mining. A strikingly ornate compartment has been constructed in the center of the Alaska building, and in this has been placed a large pan, just six times the size of an ordinary gold-washing pan, containing up to $1,250,000 worth of gold.

In one booth hydraulic placer mining is illustrated by a reproduction on a fairly large scale of the Porcupine Gold Mining Company's placer-gold mine on Porcupine creek, in the Skagway district. Flume, pipe-line, giant, gold-bearing gravel, etc., are all shown, and numerous photographs of placer-mining scenes are also exhibited.

Lode Gold

The largest exhibits of gold-bearing ores are from the Juneau district, from the Treadwell, Perseverance and Eagle river mines, and in connection with these the education idea is also kept well to the fore. The Treadwell has a small model of a 5-stamp mill in operation, and also has on exhibition large photographs of its mines and interior views of its big mills, in which there are altogether 880 stamps, 300 under one roof. The annual output of the four lode mines of the Treadwell group has a value of about $3,000,000, which is more than two-thirds of the annual lode gold production of Alaska. Their aggregate output to date is in excess of $36,000,000.

The Perseverance Gold Mining Company's mineral exhibit consists of about 1500 lb. of well mineralized quartz and 1000 lb. of gold-bearing concentrate. A large photograph of the company's 100-stamp mill shows its close proximity to high mountains and to the source of the water power which makes the mill practically independent of other provision of power for operating. Herein is another object lesson, showing that an abundance of snow on the neighboring mountains, together with glaciers and springs, supplies cheap power and so admits of very low-grade ores being worked on a large scale and with profit.

Silver

There has been practically no silver mined in Alaska other than that associated with placer and lode gold. The total production to date has been nearly 2,000,000, oz. There are, however, some silver-lead ores shown, notably a pile of ore from the Sunset mine, on the south arm of Cholmondley sound, southeast Alaska.

Copper

Next to gold, copper ores are most prominent among Alaskan mineral exhibits, 97 copper properties being represented. There are several large blocks of chalcopyrite, among them, one weighing 2200 lb. from the Ellamar mine, Prince William sound—and many tons of similar ore in smaller pieces, large specimens showing how native copper occurs in amygdaloidal greenstone (one of these being "the largest piece of native copper ore from Alaska which came from 'in place' in the mine"), and samples of chalcocite, bornite, etc.

Owners of copper properties have done much to convey a clear idea of the conditions under which copper mining can be carried on in different parts of Alaska. One striking panorama embraces a large area of the Copper river country, bringing out in relief its topography and showing the location of some of its most important mines. It also indicates the progress in providing railway transporta-

tion, showing the routes of the railways in course of construction toward the mines. Nearly 50 miles of the Copper River and Northwestern railway were completed last year, and this year at least as much more will be finished, leaving 95 miles more to be built to provide railway transportation from the Guggenheims' Bonanza mine, at Kennicott, to Cordova on the sea. The extensive deltas of the streams are also shown, indicating the existence of a considerable acreage of land available for agricultural uses.

Tin

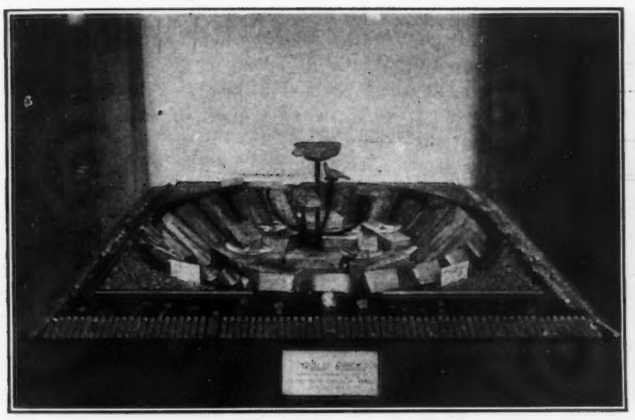
The exhibit of tin ores, both placer and lode, is of much interest since it is believed to be the largest of purely American production ever made on this continent. There is in one large show case about a ton of placer tin, and a number of kitchen plates manufactured from local tin. Other cases and stands contain lode tin ores, and associated secondary minerals, molybdenite, wolframite, and fluorite. Particular importance is attached to this display of cassiterite, since production in commercial quantities has already been commenced, according to Adolph Knopf. Up to the close of 1908 the total production of the Seward peninsula region was 160 tons of cassiterite concentrates, all of which, except a few tons from lode deposits, came from the stream tin of Buck creek. It is hoped that a valuable tin-mining industry will eventually be developed and the great demand for tin in the United States be in part met by the home product.

Coal and Petroleum

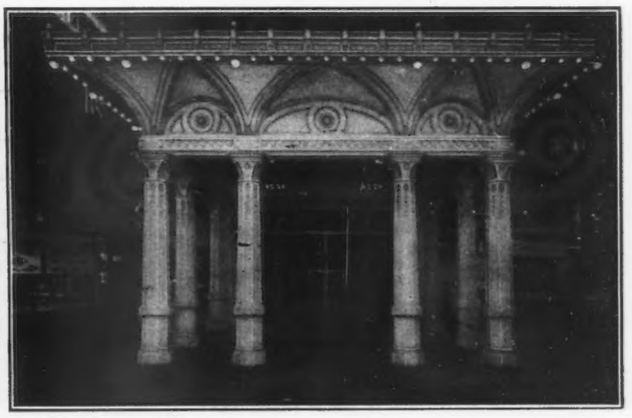
The known areas of coal-bearing rocks in Alaska cover 12,644 sq. miles, and of coal 1238 sq. miles. Lignite, bituminous and anthracite coals with some good coking coal, have been found. The lower-grade coals are the most widely distributed and occur in the greatest quantities, so far as is known. The total production to date is 45,000 to 50,000 tons. The total available tonnage of coal in the Matanuska and Bering river fields has been estimated at about 1,000,000,000 tons. The Matanuska field is officially stated to be 150 miles from an ice-free port on the Pacific, and the Bering river field 25 miles from the coast at Controller bay and 100 miles from a good harbor on Prince William sound. The construction of a railway from Katalla to the latter field will shortly be commenced.

The fuel exhibit collected by Mr. Fields includes wood, peat, lignite, and on through various grades up to high-grade anthracite. In connection with this exhibit there is a model in relief of Carbon mountain, representing a 5-mile section of the anthracite coal measures in Bering river district.

Petroleum is represented by crude oil in 5-gal. jars and by its separated component parts. This exhibit causes much surprise, few having been previously aware of the occurence of oil in Alaska.



GOLD EXHIBIT LOANED BY THE SCANDINAVIAN-AMERICAN BANK, SEATTLE



GOLD BOOTH IN THE ALASKA BUILDING, A.-Y.-P. EXPOSITION

Other Metalliferous Minerals

Of these, the most noticeable exhibit is marble, a room constructed of large slabs of light-colored marble, from Prince of Wales island, being generally admired. The material is beautifully marked, free from flint, copes readily, and is easily carved and lettered. The market for this marble in Seattle, Tacoma and San Francisco is steadily becoming larger. The well-known Vermont Marble Company lately purchased marble quarries on Prince of Wales island.

Summary and Conclusions

From Mr. Brooks' summing up[1] of the Alaskan situation, the following sentences are quoted:

Though placer mining has been carried on in Alaska for nearly thirty years, it has been chiefly by the crude methods of the pioneer that more than $100,000,000 worth of gold has been won from the auriferous gravels. The modern epoch of placer mining, with labor-saving machinery, has only just begun and the field in which such methods are used is capable of much expansion. Though the future discovery of bonanzas, such as have made Alaska famous in the past, cannot be predicted, it is certain that the possibilities of new finds are far from being exhausted, and that there are hundreds of creeks known to be auriferous which may yield gold in commercial quantities when means are found to reduce the present cost of operation.

The inland copper districts await the railway transportation which will not only lead to the development of known deposits, but also stimulate further search for orebodies. Such developments of a lode-mining industry will give a larger permanent population—at present Alaska's greatest need.

The value of the high-grade fuels of the Pacific seaboard probably exceeds that of the gold deposits, and the exploitation of these coalfields is of the greatest importance to the entire western seaboard of the continent. These coals will furnish not only the high-grade steam coals needed for various industries, but also the coke for metallurgical enterprises. If the iron ores of the Territory prove valuable, the west coast may yet be supplied from this source with the raw materials for the manufacture of iron and steel. In any event, the copper smelters can be provided with coke of a high grade.

A full development of the mining industry of Alaska is possible only by improvement of the transportation facilities. At least one railway must be built to the Yukon goldfields, and the inland copper-lode districts and coalfields must be connected with Pacific ports that are open throughout the year. Then, and not until then, can Alaska's mining industry be developed to the extent warranted by her known mineral wealth.

[1] "Mining and Mineral Wealth of Alaska," pp. 33-34.

The Prevention of Accidents in Coal Mining

Proper Supervision and Organization of Works of Greatest Value. Danger Minimized by Using Permissible Explosives and Efficient Spraying

BY E. H. COXE*

For the purpose of this discussion coal mine accidents will be divided into four different classes as follows: (1) Accidents caused by explosions. (2) Those caused by falls of rock or coal. (3) Those caused by defective or improperly protected machinery or appliances. (4) Including all other accidents.

Accidents Due to Explosions

Accidents due to explosions will be considered first, not because they are most frequent, but because when they do occur they are by far the most disastrous and widespread in their effect and so frequently happen where least expected and in mines which are considered almost explosion proof.

Of accidents due to explosions we have four kinds, sometimes two or three of these combined, classed as follows: Premature explosions; blownout or windy shots; dust explosions and gas explosions.

The premature explosions are caused, usually, by carelessness on the part of the employee, either in making up his cartridge or handling his explosive in a careless manner in the vicinity of a light from which a spark may fly, as in the case of a miner handling black powder with his cap on his head or in such position that the air will carry a spark from his lamp into the powder. A great many accidents of this nature could be prevented by proper observation and the exercise of proper discipline on the part of the officers of the mine, who, in making their rounds, undoubtedly observe some of these things being done nearly every day. And it has been my own observation in going around the mines that this sort of carelessness is exercised frequently and the man who is guilty of this practice should be discharged or severely disciplined, for he is not only endangering his own life but also the lives of all his fellow employees in the mine, as explosions of this kind will frequently stir up dust if it exists in the mine.

Premature explosions are also frequently occasioned by miners firing what is known among mine men as a "skinemback," that is cutting a fuse short and improperly tamping the charge. This is sometimes done by miners on account of the holes being wet but should certainly not be allowed. The men guilty of doing this have no place in a mine and should be discharged. It frequently results in either the shot going off before the man who fires it gets away, injuring or killing him, or in a windy shot due to the improper tamping.

Windy Shots and Their Prevention

Blownout or windy shots are usually caused by one of two things, either improperly tamping the hole or using too heavy a charge of explosive. If a shot of black powder or dynamite blows the tamping out, instead of doing the work it was intended to do, the shot comes out of the mouth of the hole, as from a gun barrel, in a long tongue of flame reaching at times, it is estimated as much as 100 ft. or more, making considerable wind, blowing doors open in the distant parts of the mine, and, in case there is any dry dust in this vicinity, stirring this dust up and exploding it, making a serious and far-reaching explosion out of what might have been, without the presence of dust, not particularly disastrous. Windy shots have, however, been known to do considerable damage without any evidence of dust having taken a part, but the presence of dust or gas makes the danger of windy shots a very grave one. If there happens to be explosives, in any quantity, kept on the side of the heading, or in a room within reaching distance of the windy shot, there is danger of an explosion and the recommendation, recently made by the State mine inspector that, in some of our mines, no explosives be kept within 150 ft. of a working face is a very good order and mine foremen should see to it that this rule is observed; also that all shots are properly tamped and not overcharged. This I realize is a very hard thing to do as it is impossible for any man, or a dozen men, to see all the holes that are loaded. But proper discipline, if exercised when a man is caught doing this sort of thing, will go a long way toward accomplishing the desired result.

I believe, however, that the greatest preventative for explosions due to any causes mentioned above, is the use of what is known as safety or "permissible explosives," such as bituminite or carbonite, both of which are extensively used in this district. Neither concussion nor heat alone will explode them so that a percussion cap, giving a combination of the two, must be used and hence the handling of them is rendered much less dangerous. And, except in very excessive quantities, the heat from the explosion is not sufficient to ignite either gas or dust. Two pounds, I believe, is the safety limit placed by the manufacturer on these explosives, and while I consider it wise to keep within this limit in charging a hole, it would no doubt take much more to produce an explosion of gas or dust, if present.

Tests of Explosive Qualities of Coal Dust

In this connection I will state that the Tennessee Coal, Iron and Railroad Company recently sent some samples of dust from four of its mines, one in the Pratt field, one in the Blue creek field, one in the Blocton field, and the other at Whitwell, Tenn., to the Government testing plant at Pittsburg, Penn., to be tested to see whether these explosives would fire the dust.

This portion of the testing plant consists of an iron gallery or tube made of boiler plate, about 6 ft. in diameter and 100 ft. long, at one end of which is a heavy nickel-steel cannon embedded in concrete. At intervals of every 5 or 6 ft. there are small heavy plate glass windows on the side of the gallery and port holes with heavy lids on the top to relieve the pressure when explosions occur.

The method of conducting the test is as follows: The dust to be used is distributed along the bottom of the gallery, as it would be in the bottom or floor of a mine and also along the sides of the gallery on shelves, as it would be found upon the gob or sides of the mine. After making a test to determine how much of the explosive is to be used as equivalent in strength to 227 grams or, about 7 oz. troy, of 40 per cent. dynamite, which is the standard charge, this amount of explosive is then charged into the cannon and tamped with 1 lb. of dry clay and set off with electricity. The first shot was loaded with 295 grams or a little over 9 oz., of carbonite No. 2, 20 lb. of dust from Johns, in the Blue creek field, was distributed in the gallery and 2 per cent. of fire damp was introduced into the tunnel where the shot was fired. The flame was scarcely perceptible at the first window, the dust was not ignited and there was no explosion except of the explosive itself in the cannon.

The next test was made with 313 grams or 10 oz. of bituminite No. 1, other conditions being the same, and the result was the same as in the previous test.

The third test was made with 500

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NOTE—Abstract of paper read before meeting of superintendents, mine foremen, assistant mine foremen, gas men, etc., held at East Lake Park, Ala., July 17, 1909, by the Alabama Coal Operators' Association.

grams, or about 16 oz. of black blasting powder, which is equal in strength to the above charge of bituminite and carbonite, all other conditions of the experiment being the same, except that in this case to avoid the possible claim that the explosion was caused by gas there was absolutely no gas introduced into the chamber. The result of this test was that there was a long tongue of flame which stirred up the dust and ignited it, the flame extending for a considerable distance out of the mouth of the chamber and throwing dirt from the ground against a heavy iron sheet suspended about 50 ft. from the mouth of the tunnel. The flame was visible in all of the windows of the chamber and issued from 12 port holes on top. Three of the port holes remained open, but the balance were thrown open with such force that they rebounded into position, these doors being hinged. Dense volumes of black smoke from this explosion issued from these port holes and from the end of the tunnel. Coke was formed in large quantities.

The results of the other tests were the same in each case, bituminite and carbonite producing practically no flame and not igniting the dust, but in every case the black powder did without the assistance of any gas whatever. I was advised by the engineer in charge that dynamite produced about the same result.

This then proves conclusively that black powder or dynamite will produce dust explosions without the aid of any gas. This is not impossible, I am advised, with these safety explosives if used in very excessive quantities. The United States Geological Survey has issued a list of what are known as "permissible explosives," the tests having been made on May 15, 1909. This includes two grades of powder (Aetna) coal powder, five grades of Du Pont carbonite, two grades of Keystone special, two grades of Potts powder coal coalite, three grades of Sinnamaboning collier dynamite, masurite, meteor dynamite and monobal, the last two grades being also manufactured by the Du Pont company. You will note that bituminite, manufactured by the Jefferson Powder Company, is not on this list, but, on inquiry I learned that the reason was that bituminite and some other explosives were not received in time to be included in this test but will be included in a supplementary list to be issued shortly.

I believe then that one of the surest methods of preventing explosions, as the result of windy or blownout shots, is to use these so-called safety or permissible explosives, and I will say that the Tennessee company is using these explosives exclusively except on two divisions where the opposition of the men to it has been very strong, and where it has been seemingly impossible to produce as good a grade of coal as with black powder. But we are experimenting at these places and endeavoring to instill in the men the proper spirit of coöperation, due from the fact that our one object in wanting to use these safety explosives is to protect the lives of the men as well as our property.

I think that all mining men should where possible use these safety explosives, and, where it is not possible, use every precaution in their power to see that shots are properly loaded and properly tamped. Mining the coal either by hand or by machine will lessen the amount of explosive necessary to break down the coal and give the ammunition a better chance to do its work and hence lessen the probability of a blownout shot, but the cuttings should be removed from in front of the hole before blasting, for fear there should be one.

Dust and Gas Elimination

The next step in the prevention of explosions, it seems to me, where gas generates, is to introduce sufficient air into the mine and properly conduct it to the working faces in sufficient quantities to sweep the gas out, or render it harmless. In the detection of gas and preventing its accumulation or ignition, the gasman's position is a most important and responsible one and he should be chosen accordingly. In doing this, however, if our mines are not already dry and dusty we are apt during dry or cold months of the year, by introducing a large quantity of air and a rapidly traveling air current, to take up and carry a considerable quantity of moisture from the bottom and sides of the mine, and to render it dry and dusty, if it was not already so, and in this case the moisture must in some way be restored.

I read recently that in an average-size mine, producing 1000 tons of coal per day and properly ventilated, 20,000 gal. of water per day were taken from the mines in the air current during the winter months, all of this being picked up from the bottom or the ribs of the mine. This seems large on the first thought, but, while I have not checked the figures, I have reason to believe they are correct. Now, to avoid explosions of dry dust we must in some manner get rid of this dust, or wet it sufficiently to render it harmless. Of course, we can remove some of the dust, but it is absolutely impossible to remove it all, especially that which is lodged in a thin coating on the timbering along the ribs and gob.

Sprinkling with a hose has for several years been resorted to, but this is not regarded as very efficient for the reason that the nature of the dust seems to be such that if there is any quantity present, where it is sprinkled from a hose, the top layer only seems to be dampened. No matter how a large a quantity of water is thrown on the dust, it simply runs off, leaving a thin coating on top which is dampened; in sprinkling it is also impossible to get into the crevices of the gob. A very much more effective method is to use sprays, of which there are several kinds: one is a homemade affair, made of a piece of 1- or ¾-in. pipe, with very small holes drilled in one side. This is not particularly efficient, as the holes soon cut out so large that the water is thrown out in a stream. Another which gives very fair results, is the ordinary copper or brass spray nozzle, such as is used on the ordinary garden hose. There are now several other very efficient sprays being manufactured. Our company has tried two of these; one is known as the Lechler spray, which is manufactured in Germany, and the other is a spray manufactured for mine or mill purposes by the American Moistening Company, of Boston, Mass. After trying all of these we have decided that the American company's spray is most effective, and we are introducing it in large numbers in all our mines; and I think the State mine inspector will back me up in a statement that in this respect we are getting our mines about as safe as they can be made.

By screwing off the cap of this spray the construction of it may be seen. It appears to split the water up and disintegrate it into a mist which seems to thoroughly saturate the atmosphere and is carried and deposited for quite large distances. The advantage of this over sprinkling is that it moistens the dust as it is carried in the air, and, instead of depositing dry dust, it deposits moist dust. The operation of this device being practically continuous there is no chance for the dust to dry and it seems to settle the dry dust carried in the air. On this device, where the spray issues, there is a removable copper bushing which can easily be changed if the water cuts it.

Tamping with coal dust is a dangerous practice, but one which is indulged in too frequently by miners and, in many places is a common practice. Clay should be provided and its use insisted upon.

Electrical Shot-firing System

After all the precautions that are being taken by various mining companies throughout the country, these same companies seem to have, occasionally, disastrous explosions, resulting in the deaths of a large number of men and great damage to property. As these explosions are always liable to occur, the next step, after using all the preventatives possible, is to fire the shots, if practicable, after everyone has left the mine. This has been done successfully for a year or two, by electricity, by the Utah Fuel Company, in their mines in Utah, a description of which will be found in the Journal of Jan. 23 and 30, 1909.

At the No. 3 Pratt mine of the Tennessee company a system of shot-firing, spraying and sprinkling is now being tried out. There are two men in the daytime and one at night called shot inspectors, or shot firers. In the daytime each one takes a certain part of the mine. In the morning their time is spent in inspecting the

wiring and making the necessary extensions, and at noon they commence their rounds, going to the working faces and carrying with them sufficient exploders to fire all the shots, giving to each miner as many exploders as he has shots to fire which meet with the inspector's approval.

After the inspector has finished his rounds, which is about quitting time, he comes to the surface, closing the switch at each entry as he comes out. He then goes to the check office where the timekeeper is stationed, this timekeeper's duty being to carefully check every man in and out of the mine. When he has ascertained to a certainty that all the men are out, and not until then, he goes to the power house and requests the engineer to close the switch at that point, watching him to see that it is done. He then goes to the check office, unlocks his box there and closes the final switch which fires the shots, leaving it closed only a few seconds; it is then opened and left open and the box locked again. He then goes to the power house to see that that switch is opened. As the night inspector comes into the mine he opens all the switches along the slope leading into the various entries so that there is no possible danger of any accident by the power accidentally being turned on the line. He then performs the same duties as the day man.

The proper tamping of the holes and connection of the exploders to the wire in the room is left to the miner, instructions being given to him by the shot firer.

The expense of installing the system in this mine, which covers a large amount of territory, was about $3500, including all labor and material, and the cost of operation, as well as we have been able to figure at the present time, will be as follows: Two inspectors or firers in the day time at $2.60 or $5.20, one inspector at night $2.60, wire and insulator for extensions $1.50, total $11.30 per day. The mine is provided with pipe lines for sprinkling and fire protection, the pumps, in all cases, being our regular mining pumps for unwatering the mine.

This covers what I have to say about what I regard as the most serious cause of accidents; the other minor causes will be treated more briefly.

Accidents Caused by Fall of Rock and Coal

In many cases these accidents are caused by the miners themselves not properly timbering their work as they should, or by not properly supporting the coal which is being undermined, or through the lack of proper care in pulling down coal or digging out what might be termed a standing shot. A great many of such accidents can be prevented by proper inspection on the part of the mine management or their duly appointed assistants; also by sufficient timbering. Frequently there is a laxness, on the part of the mine management, in the way of providing necessary timber, and, when such is provided, it is left to the judgment of the miner as to how close props shall be set, or whether they shall be set at all, the result being that a great many men, especially in districts where the roof is bad, are severely injured or killed from lack of proper or sufficient timbering, often due to lack of supervision and discipline on the part of the mine management. It is the duty of the mine foreman to see that men who are too ignorant to protect themselves are made to do so.

Defective or Improperly Protected Machinery or Appliances

These accidents happen on the surface as well as in the mine, and a great many of them could be prevented. In many cases this can be accomplished by properly guarding or shielding gear wheels, or any rapidly moving parts of machinery, such as the crank pin on an engine, which can have a rail around it; exposed gears, or pumps, or engines, which can be protected with metal or even wooden shields. In cases of electric wires, especially where high voltage is used, the wire, where possible, should be insulated, and in case of trolley wires, which cannot be insulated, they can be shielded by a 6-in. board, the bottom 3 or 4 in. below the wire, and fastened with an iron bracket between the clamp holding the wire and hanger.

This is of the utmost importance where high voltage is used, as is sometimes the case with long transmission lines. These shielding boards should be placed not over 4 in. apart, so that a man raising his head could not get it between the shielding and thus come in contact with the wire. A shock from a current as high as 500 volts is usually considered to be fatal. A still better precaution along this line is to use a lower voltage, not over 250, which is not fatal, except in rare cases. In fact, the shock from 250 volts is usually not serious unless it is continued for quite a length of time. High platforms should also be protected by hand rails to keep men from falling off.

A great many of these accidents can also be prevented by proper inspection on the part of the mine foremen, master mechanics, and their representatives. In many cases there is too great a tendency when a thing is once done right not to keep it right, but to allow it to get in bad repair, and many accidents caused by breaking of machinery, breaking of hoisting and haulage ropes, or car couplers, can be prevented by keeping these things in proper condition.

All Other Accidents

I have not tried to subdivide this fourth class of accidents, as there are too many possibilities, but, as a rule, they are due to lack of proper organization, lack of proper discipline, and carelessness on the part of individual employees; also to the failure, on the part of the employer, to furnish proper facilities and protection for employees. For instance, men are frequently hurt on the roadway on account of there being insufficient passing room for the trip, either moved mechanically or by mule power. To guard against this class of accidents there should be provided either a separate walkway for the men to go to and from their working places, or a sufficient place beside the track for a man to walk without danger of being struck by a passing trip. And, when either of these are provided, they should, like machinery, be kept in proper condition, i.e., obstructions in the shape of rock should not be piled in this place, or falls from the roof should not be allowed to accumulate so that it is either impossible, or a hardship on the man to travel what is supposed to be a traveling road. And this can only be kept in proper condition by necessary supervision and discipline. If neither of the above are practicable a manhole should be cut in the rib every 30 or 40 ft., and kept whitewashed and free from dirt or rock.

Accidents such as collisions of two trips running in opposite directions are usually the result of lack of proper discipline or system in handling the mine. Derailments, caused by defects in the track, bent axles, or any of the numerous causes, are usually the result of lack of discipline or lack of proper supervision in keeping the plant in good condition.

Summary of Conclusions

In conclusion, I will say that not only in Alabama, but in all parts of the country, there is too much of a tendency on the part of the superintendents and mine foremen, and incidentally their assistants, to produce the greatest possible amount of coal at the least possible cost, regardless of anything else. The consequence is in many cases that the energies of the whole organization are expended in the efforts to produce the greatest results today, and the fact is lost sight of that machinery cannot run forever without attention, and that no part of the mine can remain in proper working condition without being attended to. The fact that to produce coal our employees must be properly protected is also lost sight of, with the result, in many instances, that the loss of life and injury to employees, or delay, or damage to property from accidents or wrecks, will far more than offset the gain made by thinking of nothing but getting coal.

It will probably appear that I have placed a great deal of responsibility on the mine foremen and hold them responsible for a great many accidents which occur. In doing this I realize that the mine foreman has a responsible position; that he has many and varied duties to perform, and that he cannot be at all places at one time, as he is frequently expected to be, and I have thought that many of us do not give the mine foremen sufficient consideration or sufficient as-

sistance to do all that we expect of them. In a large mine they cannot do it all, but, by organizing their working force on a systematic basis, exercising proper discipline, and choosing for their main assistants men who will do the same, they can build up an efficient organization, and, by preventing many of the accidents which now happen, not only save human life and limb, but also increase output and decrease cost by avoiding delays caused by accidents.

I also, before closing, want to give the master mechanics, and electricians, and their departments, their share of responsibility in keeping the plant in proper working order and safeguarding the lives of employees, and to say that they should consider it their duty to prevent breakdowns, if possible, rather than to repair them, and by so doing their labors will be light and their burden easier to carry.

Some German Mine Props

German engineers have for a long time beeen engaged in devising mechanical props, generally made of metal, with the idea of replacing the less durable and, in Europe, more expensive timber props. Several such contrivances were descibed by Dr. Hecker in *Glückauf* of April 8 and October 24, 1908.

Angle-Iron Prop

The angle-iron prop, shown in Fig. 1, consists of two pieces of angle, the upper of which fits inside the lower. A triangular collar surrounds the upper end of the lower angle and a triangular wedge fits between this collar and the smaller angle. The outer side of the wedge is notched, to provide greater frictional resistance.

The wedge is tightened or loosened by blows of a hammer. The lower end of the stull is provided with a cast-iron acorn and the upper end with a bearing surface to receive the cap piece. Size No. 7, of about average length, has the following dimensions: Length extended, 2 m.; length closed, 1.6 m.; outer angle, 70x70x9 mm.; inner angle, 60x60x10 mm.; weight, 27 kg.; cost, 13.10 marks. If desired, the upper angle can be fitted with a screw jack as shown in Fig. 2.

Tubular Stull

A tubular stull, made of cast iron, is shown in Fig. 3. It consists of two tubes, the upper one fitting inside the lower. A heavy collar surrounds the joint, and a wedge can be driven inside the collar to hold the tubes in position. Size No. 4 has the following dimensions: Length extended, 1.9 m.; length closed, 1.325 m.; outer diameter smaller tube, 82 mm.; outer diameter longer tube, 93 mm.; thickness of both tubes, 4 mm.; cost, 27.80 marks.

Tests at Mine No. 2 of the Gewerkschaft Deutscher Kaiser, employing 2960 of the angle stulls and 100 of the tubular stulls, showed a total saving, during the year 1907, of 9071 marks as compared with the estimated cost of an equivalent number of wooden stulls.

Adjustable Temporary Stull

An adjustable stull for temporary use,

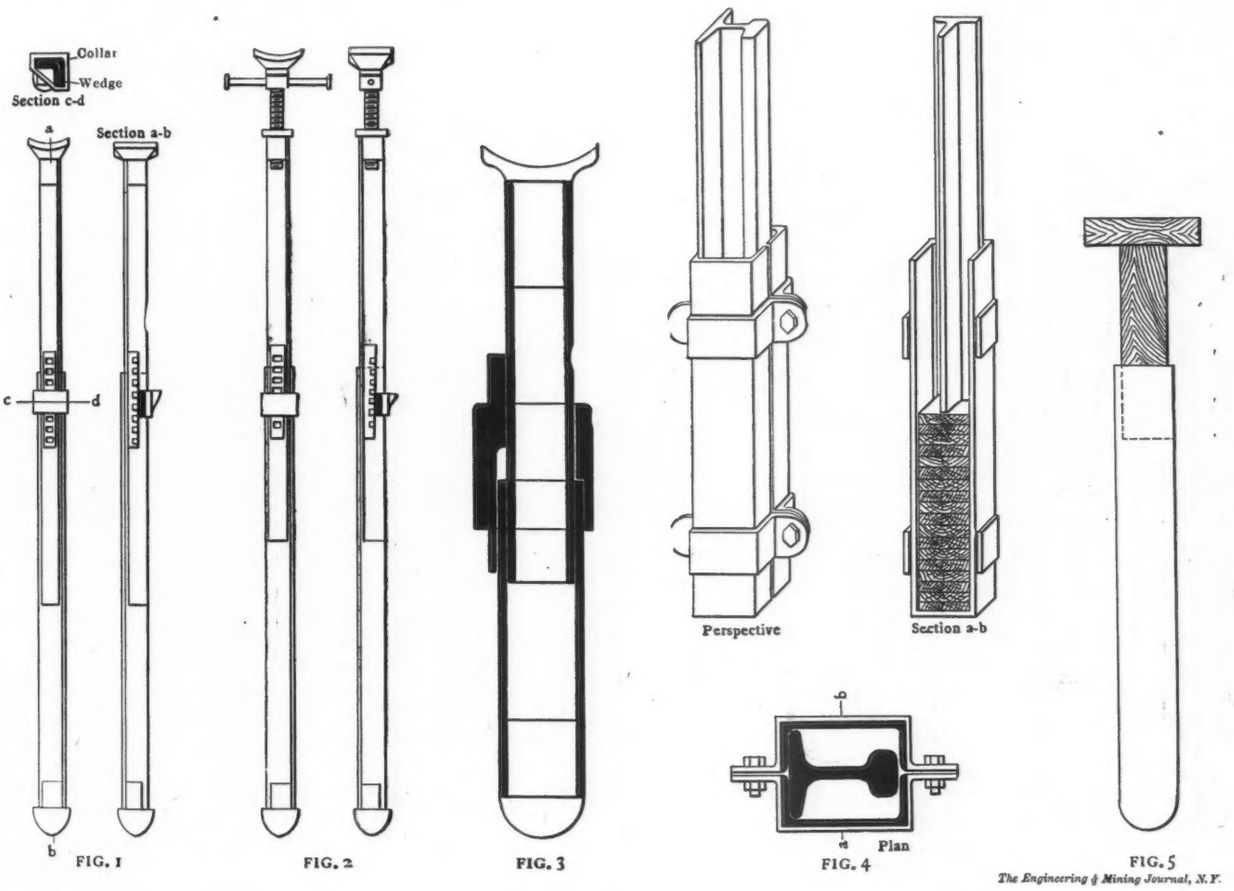

FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

The Engineering & Mining Journal, N.Y.

DIFFERENT TYPES OF STULLS

In 1908 Indiana took second place among the States in the production of cement, Pennsylvania being first. The output for the year in Indiana was 6,478,165 bbl., valued at $5,386,563; an increase over 1907 of about 2,000,000 bbl. There were eight factories in operation last year.

devised by Schmalenbach, is shown in Fig. 4. The lower end consists of two pieces of channel iron clamped together by two pairs of straps. The upper part of the stull is made of a section of rail; blocks of wood are fitted into the rectangular box formed by the two channels, to receive the pressure and to give elasticity to the stull. A test on a stull of this sort in which 10 oak blocks were used, having a total thickness of 245 mm., showed a depression of 70 mm. with a load of 10,000 kg., and of 150 mm. with a load of 30,000 kg. At a load of 20,000 kg. the five bottom blocks, and at 36,000 kg. by two lower blocks, were uninjured, while those above them were crushed.

Nellen Stull

The Nellen stull, shown in Fig. 5, consists of a cast-iron pipe closed at the lower end, but open at the top. The pipe is three-quarters filled with tamped sand and a short section of timber, standing on the sand, projects out of the pipe. Such a stull, the pipe having a diameter of 130 mm. and a length of 1.275 m., filled with sand to a depth of 935 mm., and the oak block extending 525 mm. beyond the pipe, supported, under test, a load of 32,000 kilograms.

Concrete Stull

A composite concrete stull devised by F. Nellen is shown in Fig. 6. It consists of cylindrical blocks of concrete separated by pads of peat and all inclosed in a divided sheet-steel cylinder. The concrete blocks are 20 to 35 cm. long, with various appropriate diameters, and are made of a mixture of 70 per cent. sand, about 27 per cent. of granulated blast-furnace slag, and about 3 per cent. of lime; after molding, the blocks are subjected for 10 hours to a pressure of eight atmospheres in a steam bath. The peat pads are about 5 cm. thick. The sheet-steel jacket is made in two sections, which can be locked together along the edges with soft iron clamps. The cost of such a stull, 1.5 m. long, is 30 to 35 pffennig, exclusive of the jacket, which costs about 2 marks. A test of one of these stulls was made in the following manner: A tubular jacket, 1.6 m. long and 118 mm. diameter, was filled with four cement blocks, each about 300 mm. long, with a 50-mm. pad between every two blocks. On a pad surmounting the upper block was placed a short wooden block 420 mm. long, making a total length of 1.82 m. and a total weight of 56.5 kg. With a load of 800 kg. the stull showed a decided shortening; at 13,400 kg. the wooden block was compressed to the end of the stull jacket, showing a shortening of 220 millimeters.

An improved type of the stull just described is shown in Fig. 7. It consists of a cylindrical steel jacket in two halves, one of which is continuous throughout its length, while the other is cut in two just below the middle, in such a way as to leave a narrow, horizontal slot. A wooden block, 40 to 65 cm. long, fits into the upper end of the jacket and is reinforced by a ring around its upper end. The two halves of the jacket are clamped together by four ring clamps.

The lower part of the jacket is filled with peat, the upper part is then nearly filled with sand and the wooden block is inserted. One of the clamps ordinarily covers the slot in the side of the jacket, but if it is desired to loosen and remove the stull, the slot is opened and some of the sand raked out. The weight of a stull having a jacket 1.5 m. long, or a total length of about 1.8 m., and a diameter of 120 mm. is 40 kg., of which the steel jacket alone weighs 15 kg. The price of a stull having a tube 100 mm. diameter and 1 m. long, complete with clamps, blocks, etc., is 7 marks.

Nonius Stull

The Nonius stull, Fig. 8, is made of two telescoping sections of pipe, without distinguishing top or bottom parts. Both sections of pipe have slots cut through them in such a way that, while the slots of each section are diametrically opposite, the slots of one section do not register exactly with those of the other section. This insures that, at any position of the two sections, at least two sets of slots shall be continuous clear through the stull, and can receive wedges, by which the length of the stull can be adjusted to take the load. A certain-sized stull has an outer diameter of 72 mm., a maximum length of 1.97 m., a minumum length of 1.10 m., weighs 18 kg., and costs 14.55 marks.

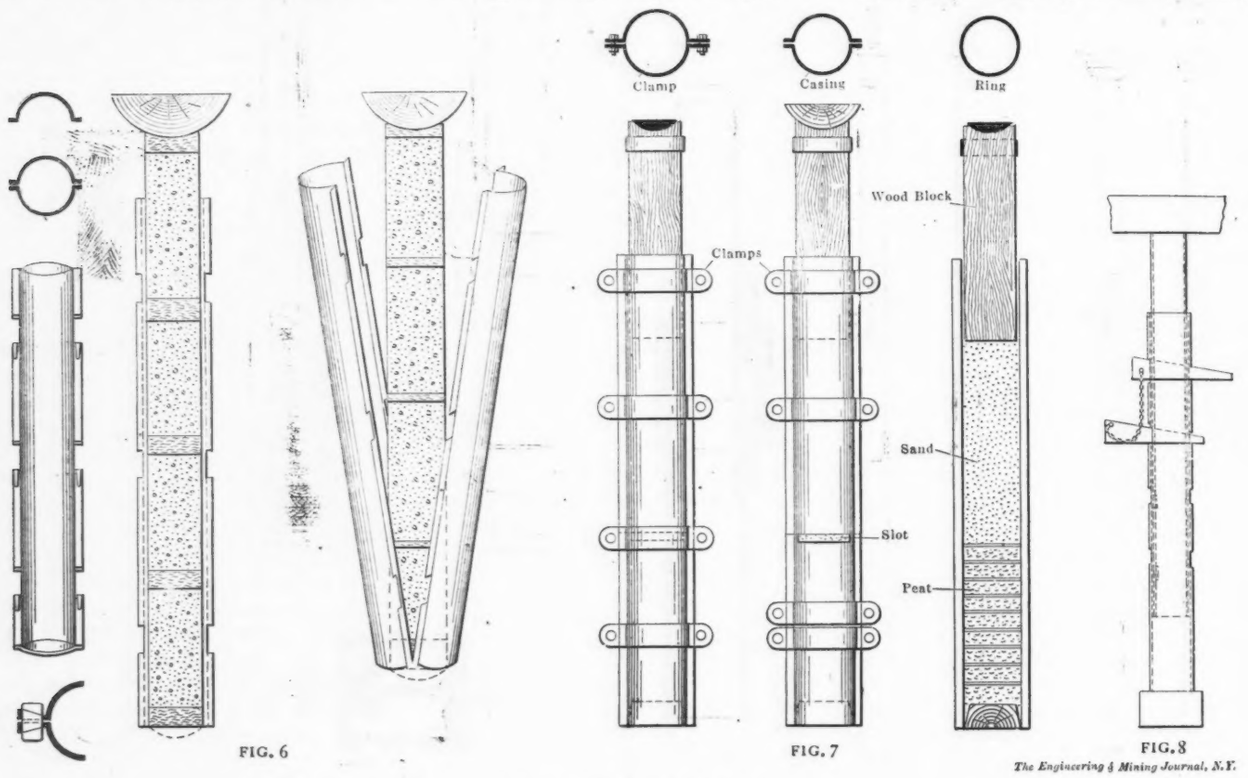

FIG. 6 FIG. 7 FIG. 8

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NONIUS AND NELLEN STULLS

Concentration at the Butte Reduction Works

By A. H. Wethey*

The smelting plant of the Butte Reduction Works is situated about 1½ miles south of Butte, Mont. Most of the ore treated comes from what are known as the Clark mines, and is brought down by the street railway in self-dumping ore cars and discharged into bins at the plant. Other ore comes from various parts of Montana in railroad cars, and some ore is still hauled by teams. The works was first established in its present location in 1885 but no part of the old plant now remains. The plant is essentially a custom smelter, as the Colusa-Parrot Mining and Smelting Company which owns the plant does not own or operate any mining property.

The principal ore supply is low grade and requires concentration before being smelted in the furnaces; the other portion comes as smelting ore of high enough grade to go direct to the smelting furnaces after being crushed and sampled.

Concentrating Plant

Treatment of the Ore—The second-class ore intended to be concentrated is discharged into a series of bins from which it passes through a 15x30-in. Blake crusher. On each side of the crusher is a bin that will discharge directly into it, the ore first passing over an electric magnet built by the Electric Controller and Supply Company, of Cleveland, for removing pieces of iron and steel which come from the mines with the ore; then over a grizzley (which takes out all the fine material) to the crusher itself. As these two bins which discharge directly to the crusher are not sufficient to handle all the ore, a conveyer is used to bring the ore from other bins. This conveyer discharges the ore over another magnet and grizzley before reaching the crusher. The pan conveyer used was purchased from the Jeffrey Manufacturing Company, of Columbus, Ohio.

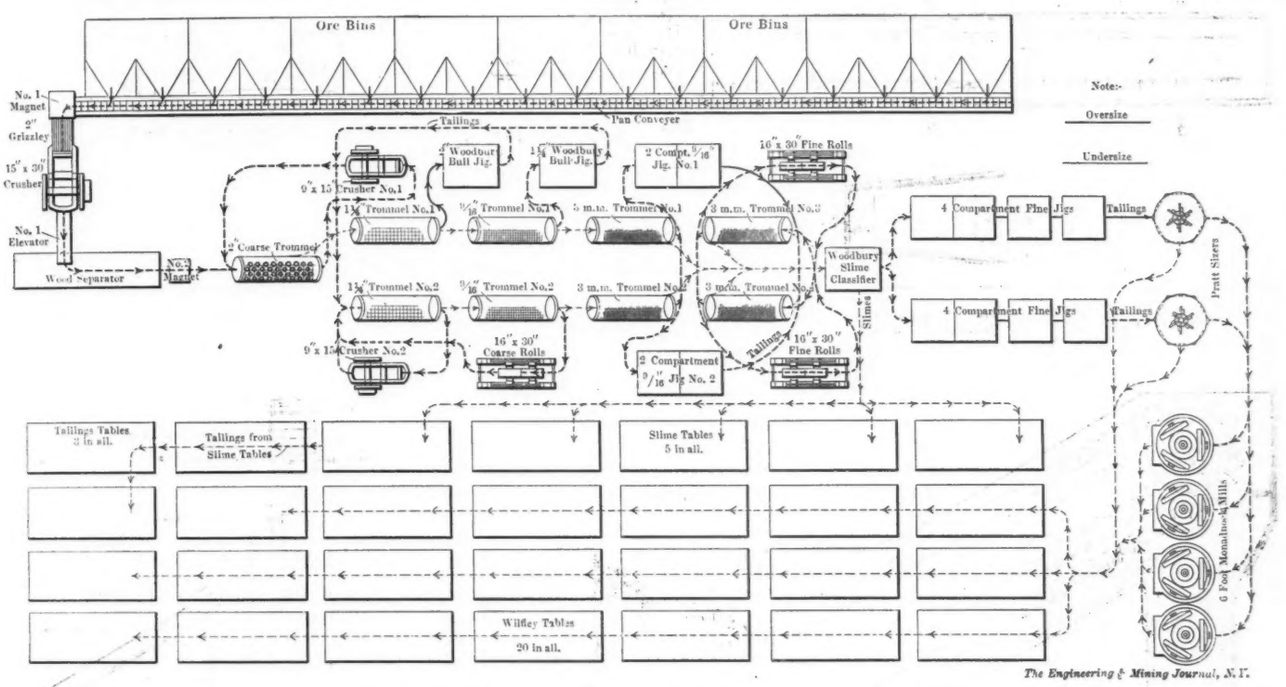
The fine ore passing through the grizzley and the coarse ore passing through the crusher are carried up together by a bucket elevator to the top of the concentrating plant, where the ore is all discharged into a tank of water in order to remove the wood which comes down from the mines with the ore. The ore is removed from this tank by a small bucket elevator, the buckets having numerous perforations through which the water passes and returns to the tank, and the wood is washed automatically over an outlet provided for that purpose. The wood and water pass over a perforated screen which separates the wood and allows it to go down into a pocket where it is collected. The water passes to other concentrating machinery. Over 40 tons of wood per month are removed from the ore by the method described.

The ore carried up by the elevator is discharged into a trommel having holes 2 in. in diameter. All the material too coarse to pass through these holes goes to 9x15-in. Blake crushers and is reground.

The fine material passing through the trommel goes to a trommel having holes 1¼ in. in diameter. The oversize goes to a so-called "bull jig" (built by the National Ore Concentrator Company, of Great Falls) and the undersize to another trommel having holes 9/16 in. in diameter. The oversize from this trommel goes to a second bull jig, and the undersize to another trommel, having holes 3 mm. in diameter. The oversize from this 3-mm. trommel passes to 2 two-compartment Pratt jigs, and the undersize to two Woodbury slime classifiers, built by the National Ore Concentrator Company, which separate the slimes from the fine jigging ore.

The tailings from the first bull jig go to two 9x15-in. Blake crushers and then to a second trommel having holes 1¼ in. in diameter, the oversize returning to the crushers and the undersize to a second trommel having holes 9/16 in. in diameter. The oversize from this trommel goes to one set of 16x30-in. rolls, built by the Montana Iron Works, of Butte, and the undersize to a second 3-mm. trommel. The oversize from this trommel goes with the oversize from the first 3-mm. trommel to the two-compartment Pratt jigs, and the undersize to the two Woodbury slime classifiers.

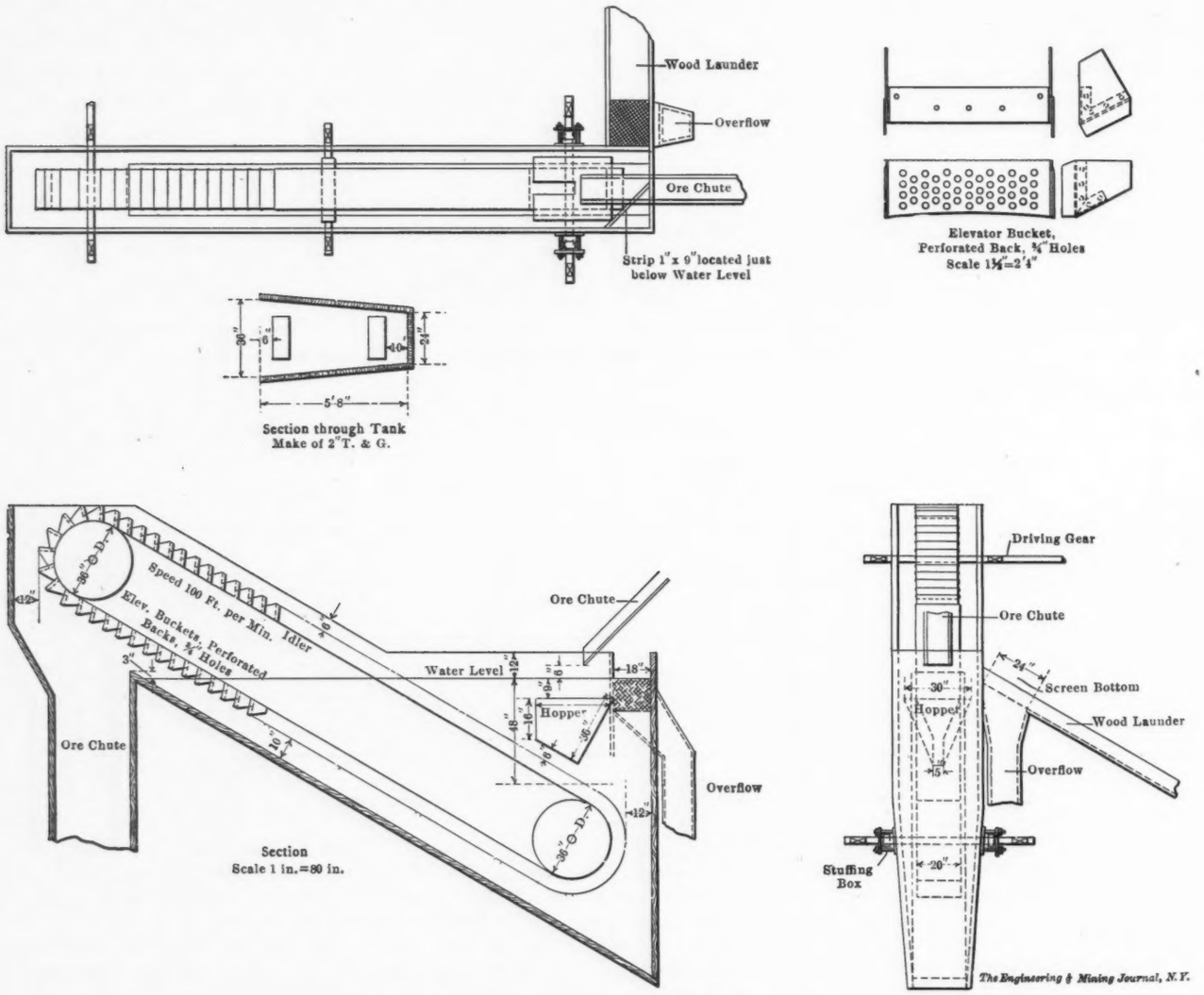
The tailings from the two-compartment jigs go to two sets of 16x30-in. rolls and then to two more 3-mm. trommels, the oversize returning to the rolls and the undersize to the two Woodbury slime classifiers. The jigging ore from the slime classifiers goes to two four-compartment Pratt jigs, and the slimes to Woodbury and Overstrom tables.



FLOW SHEET OF 500-TON CONCENTRATOR, BUTTE REDUCTION WORKS

*General manager for W. A. Clark, Butte, Mont.

The tailings from the four-compartment jigs go to two Pratt ore separators, the fines from the separators going to Wilfley (built by the Mine and Smelter Supply Company, Denver), and Overstrom (built by the Allis-Chalmers Company, Milwaukee) tables, and the oversize to chilian mills furnished by the Trent Engineering and Machinery Company, Salt Lake. The fines from the chilian mills go with the fines from the ore separators to the tables. The Pratt ore separators and jigs were designed by Fred Pratt, the foreman in charge of the concentrating plant of the Butte Reduction Works, and were built in the local shops at the plant.



WOOD SEPARATOR USED AT BUTTE REDUCTION WORKS

But few carbonate ores, upon which was built the original iron industry of Ohio, are now used, and in a number of other sections of the country deposits of iron ore, which in earlier years supported industries, are inactive; in fact, the knowledge that such industries existed has passed from the majority of the people.

Geology and Mining in Mexico

SPECIAL CORRESPONDENCE

The mining companies of Mexico seem to be awakening to the need and advantage of thorough and competent geologic and scientific investigations of their properties. The firm of Spurr & Cox, Inc., of Mexico City and New York, has made in the past year for the American Smelting and Refining Company and allied interests, examinations in Aguascalientes, at Velardeña, Durango, and in Nuevo Leon. The same firm has made an investigation of the Esperanza mine at El Oro and is now engaged in a geologic survey of the Peñoles Mining Company's property at Mapimi in Durango. E. Ordoñez, a geologist of Mexico City, is engaged on a geological study of the mines of the Real del Monte y Pachuca company, in the state of Hidalgo. C. W. Botsford, an American geologist, has been for some time engaged by the Guanajuato Development Company in studying the geology of the important Guanajuato district, and has made investigations at Zacatecas and in Sonora for private companies. An American syndicate recently arranged for a reconnaisance of the Guerrero and Michoacan region by skilled geologists.

These are a few of the investigations recently made by scientific men in the interests of Mexican mining. The need of such work is great in Mexico because the limited staff of the Mexican Institute of Geology, which corresponds to the United States Geological Survey, has been unable to undertake any extended economic work in connection with the mining districts. Also it is held by many that the Institute devotes too much of its energy to strictly scientific work, especially with the great existing need for economic investigation in the interests of mining. At any rate, some very important work is being done in geologic investigation in Mexico now, and more or less of the results are becoming general information for the benefit of the public from time to time.

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**Illustrated.*

The Tariff on Iron Ores

The reduction of the duty on iron ore to 15c. per ton, on careful consideration, does not appear likely to result in any important changes, or in any detriment to our own mines. In the case of Cuban iron ores, which have constituted about two-thirds of our imports, the new duties are less than the amount named. By the reciprocal trade agreement between the United States and Cuba, the latter obtains a concession of 20 per cent. below the existing tariff rates, so that the duty on Cuban ore is only 12c. per ton.

For a series of years past the imports of iron ore into the United States have averaged about 3 per cent. of the total supply. If we deduct the exports—which are chiefly of Lake Superior ores to Canadian furnaces—the proportion of foreign ores used in this country is less than 2 per cent. of the total. Of these imports about 70 per cent. come from Cuba, about 20 per cent. from Europe—chiefly Spain—and about 10 per cent. from Newfoundland. It is not likely that the latter sources of supply can send us any great increase in quantity. The Spanish mines are not increasing their output, and any improvement in the iron trade of Great Britain and Germany will diminish the surplus sent here. It is much the same case with the Newfoundland ores, which find their chief market in Canada, their surplus for sale depending chiefly on the activity of the Canadian trade. No large quantity of ore comes to this country from Canada as yet. The chief increase in imports must therefore be in Cuban ores; unless, indeed, there should be some development of the iron deposits of Brazil and Venezuela, which are believed to be extensive. That, however, is entirely in the future, and need not be taken into account at present.

That a considerable increase in the mining of iron ore in Cuba, and its importation thence into this country, is not only possible but probable, appears certain. It must be remembered, however, that a limit on the use of such ores more effective than the tariff is found in the railroad rates from the seaboard. This limit will probably be found to have its line approximately coincident with the Alleghenies. To furnaces east of that line, Cuban ores will furnish the mixture they need with local ores, and will, to a great extent relieve them from the disadvantage they now suffer from, as compared with furnaces west of the line, in the high cost of freight on Lake ores for that purpose. Quite probably this will make possible the continuous operation of some furnaces which can now only be run at a profit during periods when demand for pig iron is heavy and prices are high.

Looked at from the other side, this is not at all likely to diminish seriously the trade or the profits of our own iron mines. By far the greater part of our pig iron is made in the Central West, where Lake ores find their chief and natural market; and in the South where the supply of local ores is so large and of such quality as to preclude any possibility of imports. That part of the demand which is likely to be filled by imported ores is too small to be of great importance; and we believe that this will be realized as the results are gradually worked out by time and experience.

The Labor Question in the Transvaal Mines

The labor question is once more beginning to be of serious interest to the mine managers of the Transvaal. Probably it has never been quite absent from their minds, though for two years past there has been a sufficient supply for the time being, and the number of Kafirs brought in increased from month to month, as the Chinese mine laborers were gradually deported under the law forbidding the renewal of their contracts. This was chiefly due to the facts that public works and railroad construction were almost stopped, and that general business in the country, outside of the mines, was not prosperous. Partly also it resulted from outbreaks of cattle disease and other troubles which forced the natives to seek work for their support. The Kafir "boy," when he finds it necessary to work at all, decidedly prefers outside work to that in the mines, where discipline is more strict and the conditions harder. For several months past, however, general business has shown a marked improvement in the Transvaal, and there has been also a partial resumption of public and other construction work. The Native Labor Association—the coöperative body which supplies laborers to the mines—has found it more and more difficult to recruit negroes; while the num-

ber of Chinamen was, of course, constantly decreasing.

The total number of laborers employed in the Transvaal mines—not including white men, who are mainly foremen, gang bosses, miners and overseers—at the end of July was 154,844, of whom 5370 were Chinamen and 149,474 Kafirs, according to the returns of the Chamber of Mines. This was a decrease of 4794 during the month of June, at a time when more labor was badly needed. As compared with January of this year, there was a loss of 6563 men, of whom 5855 were negroes and 708 Chinamen. The Native Labor Association has been unable to keep up the supply, although it has extended its recruiting ground into Portuguese territory at a long distance from the mines. In June the number of laborers lost was considerably greater than those received, and this condition will probably continue; while the total elimination of the Chinese is only a matter of a few months.

Some Witwatersrand managers estimate that before the close of the present year at least 190,000 men could be profitably employed in the mines. Where the increase of 35,000 men is to come from it is not easy to see, when it seems difficult to keep up the present number. Possibly the total given is an over-estimate, but the requirements for labor are certainly increasing with the extension of development, and the prospective opening of more deep-level mines. To fill the demand promises to be a serious problem.

Since the Chinese law was passed, over 45,000 Chinamen have been returned to their own country on the expiration of their labor contracts. This labor movement has been accomplished quickly and with very little friction, and we hear no more about the troubles which were prophesied when the law was adopted. In another year the Chinese episode in the Transvaal will have become a matter of history.

Hydraulic Mining Difficulties in California

There has been a further check to hydraulic mining in California, and some operations in the gravel-mining counties have shut down entirely, because the California Débris Commission has decided that hereafter all dams constructed for holding back débris or tailings must be of stone or concrete. Heretofore large numbers of these dams have been built of logs or even brush. In most instances the miners cannot afford to build expensive concrete dams, and if this ruling be enforced there will be fewer hydraulic mines started and operated than ever.

In the smaller mountain towns, where operations are not upon a large scale, the brush or log dams appear to have answered the purpose of holding back the débris, and miners have been permitted to continue hydraulicking. With recent changes in the personnel of the commission the rules have been made more rigid and more difficult to comply with than those formerly in force. The commission is given the right by Congress to formulate such rules as it sees fit, and the miners must comply with them, or have their properties closed down. It looks now as if these new rules were such as to shut out the small operator altogether and allow hydraulic mining in the region affected only by the larger companies, which are able to stand the expense required for permanent dams. There is, of course, much complaint from those who have had to shut down, but there appears to be no redress.

British Mine Taxation

The British Chancellor of the Exchequer has, wisely, abandoned the proposal to tax "ungotten minerals," which he recently submitted to Parliament. It soon became evident—in fact it was evident from the first—that the attempt to levy such a tax could only result in endless confusion and litigation. The Chancellor himself, when it came to the point, was unable to indicate any method of determining the quantity and value of the minerals which would be subject to the tax. He might, had he known of them, have been warned by the failure of the attempts made in several States in this country to tax property in accordance with the supposed value of its mineral contents. No equitable method of assessing such taxes has yet been devised, and it is not probable that any ever will be.

The place of this tax in the budget is taken by a tax on "mining royalties, dead-rents and wayleaves;" that is, upon the income derived from mining property by those who do not work it themselves, but leave the operation to others. Two objections have been made to this special tax, the first being that to a large extent it will duplicate the income tax. This can, of course, be met by omitting receipts from royalties from the total of taxable income.

The other objection, which seems more difficult to meet, is that the royalty represents, or is supposed to represent, the gradual depreciation in value resulting from the removal of mineral from the land. It would seem hardly fair to tax an owner on the decrease in value of his property, however it might be to tax him on an increase. The certain effect of such a tax, moreover, would be an increase in royalties wherever it could be made, and the consequent incidence of the tax on the mine operator and not on the mineowner.

For the first time, apparently—judging from the various public discussions of the proposals—English financiers are beginning to realize the difficulties attending the taxation of mining property as such. Fortunately the British tax system is flexible, and an unpopular or clearly inequitable tax is not likely to last over a year.

Steel Making on the Pacific Coast

The reorganization of the company operating at Irondale, Wash., and the improvements made in its plant are a matter of interest to the Pacific Coast. It is the first serious and carefully considered attempt to establish the manufacture of iron and its subsequent conversion into steel and finished material on the coast. Wrought iron and steel have been made in California for a number of years in several mills and furnaces, using pig iron imported or brought from the East and scrap collected locally, but they did not carry through the whole process as it is to be worked out at Irondale. The old charcoal furnace there, which has been operated intermittently, has been rebuilt as a coke furnace of larger capacity, and the company has added open-hearth steel furnaces and a rolling mill.

Some prominent mining engineers appear to have ambitious political aspirations. It is gossiped that John Hays Hammond will sooner or later have a post in the cabinet. D. C. Jackling, of the Utah Copper Company, is said to be desirious of representing Utah in the Senate.

Steel Works on the Pacific Coast *

The Irondale Steel Company, Seattle, Wash., is building a small steel plant which it expects to operate in connection with its blast furnace at Irondale, near Port Townsend, Wash. The additional equipment, now under construction, consists of two 20-ton open-hearth furnaces and three rolling mills, 22 in., 14 in. and 9 in., respectively.

The new plant is something of an experiment because it marks the first serious attempt to manufacture steel west of the Rocky mountains. A small plant is being built partly because of the experimental nature of the undertaking and also on account of the relatively limited market on the Pacific slope.

The price of steel scrap in the Pacific States is relatively very low, due to the absence of steel foundries and open-hearth plants which consume a large amount of scrap. Ordinary prices range from $6 to $11 per net ton, depending on the quality, against $12 to $16 in the East. Considerable quantities of steel scrap are shipped from the Pacific Coast to the Atlantic seaboard and to Europe. It is the purpose of the designers of the Irondale plant to take advantage of this condition and use as large an amount of scrap as possible in the open-hearth furnaces, together with some of the pig iron from the blast furnace. The annual consumption of all iron and steel products, except heavy rails, in the States west of the Rocky mountains, including export business, is about 1,500,000 tons. The new Irondale plant will have an approximate annual capacity of 21,000 tons of pig iron and 45,000 tons of steel. The plant will be prepared to roll squares and rounds from ¼ up to 4 in., 20 ft. long; flats up to 3x10 in., also angles and channels up to 7 inches.

The plant originally consisted of a blast furnace with a capacity of 70 tons per 24 hours and a number of stationary charcoal kilns. This furnace was operated on charcoal which was produced from sawmill refuse purchased from the lumber mills in the vicinity. The furnace was last blown out in January, 1908. The stack has been repaired and is now in condition to be blown in.

The company was reorganized at the close of last year and reincorporated with a capitalization of $1,000,000. James A. Moore is president; John Schram, treasurer; M. M. Lyter, secretary; William Price, manager; R. A. McLellan was only recently appointed chief engineer and Oscar Stromberg is consulting engineer.

The company owns coal properties in the Tacoma district and the blast furnace will hereafter be operated on coke made from this coal. This distance from the mines to the furnace is about 60 miles. The iron-ore properties operated by the company are located in Washington and British Columbia at distances about 50 and 350 miles, respectively, from the furnace.

The new open-hearth department consists of two 20-ton furnaces designed by Oscar Stromberg, consulting engineer. The furnaces are fired by oil and the melting chamber is 22 ft. in length and 11 ft. 3 in. in width. The hearth will be made of Austrian magnesite. The air regenerators will be 16 ft. x 12 ft. 3 in. x 14 ft. 8 in. The slag pockets are situated directly under the downtakes, of which there are two, 2 ft. 6 in. x 4 ft. 6 in. The weight of the hearth is carried on brick piers which support six I-beams on which the rails supporting the brickwork are laid. The air valve is of the ordinary Siemens butterfly type. The oil burners are supported on the melting platform and can be withdrawn from the furnace at will. The oil is atomized by steam and is supplied under 60 to 80 lb. pressure at 250 deg. F. The ladle equipment consists of three 25-ton ladles designed by Mr. Stromberg. The steel will be tapped into a ladle resting on an electrically operated car, from which it is tapped into small ingots.

Bottom-poured or rising ingots will be cast. The ingot molds are 8¾x10 in. inside; the walls of the mold are 3⅝ in. thick at the bottom and 2¾ in. at the top. The ingots will be 4 ft. 3 in. in length and will weigh about 965 lb. each. The molds are made open at both ends and are set on a specially designed bottom-cast plate. Twelve molds are set on a single plate and cast from one 6¾-in. runner. The plate is provided with slots which hold the clay pipes that conduct the metal from the central runner to the various ingot molds. The bottom-cast plate is made of cast iron; it is 8 ft. long by 6 ft. 1½ in. in width and 6 in. high, the thickness of the metal being 2½ in. The casting pit in front of the open-hearth furnace is 40 ft. long, 8 ft. wide and 5 ft. deep, with a cinder pit at each end 8 ft. wide by 5 ft. deep.

Two coke-fired heating furnaces are situated just in front of the casting pit, while a third furnace is adjacent to the 9-in. mill.

The rolling mills, which are placed in two parallel rows, are located in front of the casting pit. The 22-in. mill is nearest the furnace, with the 9- and 14-in. mills placed 115 ft. back of the 22-in. mill. The mills are to be direct driven by Corliss engines; the boilers are six in number, 500 h.p. each, three being of the Badenhausen water-tube type designed by John Badenhausen, of Seattle.

*Abstract of article in the Cleveland *Iron Trade Review*, Aug. 19, 1909.

The average wage paid at the Dolcoath tin mine (*Queensland Government Min. Journ.*, Feb. 15, 1909) in Cornwall during the past three years was £6 per month.

The American Mining Congress

The American Mining Congress will hold its twelfth annual session at Goldfield, Nev., Sept. 27-Oct. 2. A program is being arranged which will include a discussion of various matters pertaining to the welfare and progress of the mining industry, the aim being to give greater opportunity for practical discussion, and consume less time in the reading of technical papers.

During the past year the Congress has had several committees at work conducting investigations, report of which will be made to this session. These reports will be open for discussion, and the committee reports will be presented as follows:

On Vertical Side Line Law, by George W. Riter, Salt Lake City, Utah, chairman.

On Coal Tax Insurance Fund, by Samuel A. Taylor, Pittsburg, Penn., chairman.

On General Revision of Mining Laws, by Walter R. Ingalls, New York, chairman.

On Standardization of Electrical Equipment, by Dr. Edward B. Rosa, Washington, D. C., chairman.

On Prevention of Mine Accidents, by H. Foster Bain, San Francisco, chairman.

On National Forest Service, by Col. A. G. Brownlee, Denver, Colo., chairman.

On Alaskan Mining Laws, by J. L. Steele, Landlock, Alaska, chairman.

The silver question will be discussed with a view to devising means of bringing about a greater use of silver, and decreasing the rate of exchange between the United States and countries using a silver standard. Moreton Frewen, of London, England, James J. Hill and John Hays Hammond, have been invited to speak on this subject.

Goldfield citizens are making elaborate arrangements for showing the district to the delegates, and the State of Nevada has appropriated $5000 to pay the expense of collecting and classifying a comprehensive display of minerals, which is being installed at Goldfield.

The Congress will consist of the regular members of the organization, and all duly appointed delegates, who have equal powers in all the deliberations of the open body. Mining men contemplating attendance should address J. F. Callbreath, Jr., secretary, at Denver, Colo., for more complete information.

The Wolfram Mining and Smelting Company has been organized in London to acquire as going concerns the two wolframite mines of Panasqueira and Cabaco da Piao, these properties having been worked by Sociedade de Minas de Wolfram em Portugal, situated in the province of Beira Baixa and district of Castello Branco, Portugal. The Panasqueira mine is already equipped with machinery.

Cost Analysis of Stone Consumption in Underground Diamond Drilling

By Benjamin H. Case*

The cost of carbons and borts consumed in boring 39 underground holes at the Burra Burra and London mines, Ducktown, Tenn., is shown in the table accompanying this article. The holes were drilled in 1907, with two Sullivan machines of the "S" type, and all but three holes, aggregating 284 ft., were horizontal across the formation. The core was 15/16 in. diameter, and the holes 1½ in. diameter.

The highest cost per foot was $3.66, in a horizontal hole started in the footwall, and drilled to a depth of only 8 ft., consuming 1 61/64 k. of $15 borts. Excepting this hole, which penetrated very hard blue quartz, the highest cost for a hole drilled with borts was $0.8338 per ft. This hole was drilled in the footwall of the Burra Burra mine to a depth of 52 ft., 37 ft. being in hard silicious vein material and 15 ft. in country rock; 2 57/64k. of $15 borts were consumed in boring it.

The lowest cost per foot was $0.0321, and was obtained from a horizontal hole bored to a depth of 190 ft. in the hanging-wall of the Burra Burra mine. This hole penetrated 10 ft. of vein material at its mouth, and the remainder cut through soft mica schist so thinly foliated that there were but few pieces of core recovered more than ½ in. thick. The stone consumption was only 39/64 k. of $10 borts.

Cost Using Carbons

The highest cost of a hole drilled with carbons was $1.155 per ft. This hole was drilled in the footwall of the London mine to a depth of 92 ft., and penetrated 22 ft. of vein and 70 ft. of country rock. The loss in stones was 1¼ k. at $85. The lowest cost with carbons was $0.0718 per ft., from a hole in the footwall of the London mine which penetrated 30 ft. of vein, and 44 ft. of country rock. The stone consumption for the hole was 1/16 k., at $85.

Cost Using Borts

The stone consumption given in the table does not take into account the loss from scrap borts in the drilling. This loss was: 4 58/64 k. @ $15, $73.59; 5 57/64 k. @ $10, $58.90; total, 10 51/64 k., $132.49. The above amount distributed to the 2948 ft. drilled wholly and in part with borts gives an additional cost of about 4½c. per ft. for holes drilled with these stones. There was no loss in carbon scrap, this loss occurring usually when the stones have worn too small to be utilized in a bit.

Summarizing, and leaving out of the calculations those holes where both borts and carbons were used, the costs with borts were for 2781 ft. drilled, $687.12, or the cost per foot, $0.247. The additional loss for scrap, which amounted to $0.045 per ft., brings the cost up to $0.292 per ft. This is considerably less than the carbon cost of $0.5090, given in the table.

ANALYSIS OF STONE CONSUMPTION.

Feet Drilled.			Stones Consumed.	Cost per Carat.	Total Cost.	Consumed per Foot.	Cost per Foot.
Total.	Vein.	Country.					
1437	411	1026	25 13/64 k.	Borts at $10.....	$258.60	1.151/64 k.	$0.18
546	65	481	16 17/64 k.	Borts, 7 13/64 @ $10.... 72.03 Borts, 9 4/64 @ $15.... 135.94		1.304/64 k.	0.3809
798	226	572	14 13/64 k.	Borts at $15.....	220.55	1.179/64 k	0.2764
167	90	77	8 33/64 k.	Borts, 6 13/64 @ $15.... 99.84 Carbons, 1 33/64 @ $85.. 154.06		3.246/64 k.	0.9225
840	228	612	5 2/64 k.	Carbons at $85.....	427.66	0.383/64 k.	0.5090
3788	1020	2768	70 4/64 k.	Totals and averages..	$1368.68	1.184/64 k.	$0.3613

Adaptability of Each Stone

Borts may be profitably used in drilling soft ground, but in hard material they are useless, as the stones, all of which contain flaws, will shatter when encountering hard rock. It is doubtful if borts could have been used with cheaper results in drilling the 840 ft. that were drilled with carbons. Some of this ground they would not have cut without great waste. Where part carbon and part borts were used, the carbons were substituted for the borts when it was found that the borts would not stand the work.

In some formations, where there are strata or zones of varying degrees of hardness, bits set with carbons might alternately be used with those set with borts, but the bits could not very well be set in advance owing to the varying gage of the hole.

*Mining and civil engineer, 63 Atkin street, Asheville, N. C.

Development Work*

If a mining venture is likely to prove payable, then the objective should be to win the asset as soon as possible, so that it can earn still more profit. If it is found not worth going beyond the prospecting stage, then the sooner that knowledge is acquired the better, for it is cheaper to do this quickly than to drag on indefinitely. At first, when opening up a mine, a limited number of men can be employed, until the main entrance, whether it be by shaft or adit, is sufficiently far advanced to warrant levels or crosscuts being put in. The called-up capital is not earning interest while such development is going on. Therefore, a good organizer will push on with the dead work, even if he has to pay a bonus over and above a fair rate, so as to encourage the miners to work their best.

This fact is recognized by the more up-todate directors, and recently the managers of an optional mine were instructed to "crowd on development work as much as possible, in order that we may not only obtain the most economical results (there is nothing so extravagant as development on a small scale), but also in order that we may obtain knowledge of the mine, and its possibilities, at as early a date as possible."

Carry Development with Production

When a mine has once been opened up it is naturally cheaper to carry on development at the same time as productive work, than to work the mine to a temporary standstill, and then start developing again. In the former case development shares the standing charges, such as management, pumping, engine drivers, etc., with the productive work. In the latter case development has to stand the whole cost. Not only that, but, as a rule, fewer men can be engaged on development than on productive work, as there are more faces to be worked in stopes, than in drifts, winzes and shafts. The consequence is that the services of certain men have to be dispensed with, and labor conditions become disorganized.

Then, again, if we look at it from a market point of view, this irregular way of working a mine gives to those who desire it every opportunity to run the shares up or down, irrespective of the real value of the mine. It is more advisable to push on with development, even if one has to borrow to do so; later on, ore can be got out quickly, or the output curtailed, according to the market price of metals or other conditions that may affect the management.

*From *Aust. Min. Stand.* June 30, 1909.

Details of Practical Mining

Notes of Interest to the Operators of Small Mines as Well as of Large Mines. The Things That Have to Be Done in Everyday Mining

REPORTS FROM EXPERIENCE

Readers of the JOURNAL are invited to contribute to this department. Articles should be brief, thoroughly practical, and preferably illustrated by drawings or sketches. Our draftsmen will prepare properly any kind of a pencil sketch that is intelligible. Something that is an old story in one district may be quite unknown in another. Articles accepted and published are suitably paid for.

Some Mining Appliances in Western Australia *

BY O. B. WARD†

The accompanying sketches illustrate some useful devices which have been designed and used at the Lake View Consols mine in Western Australia, in connection with underground work; each of them has proved itself efficient and economical in practical use.

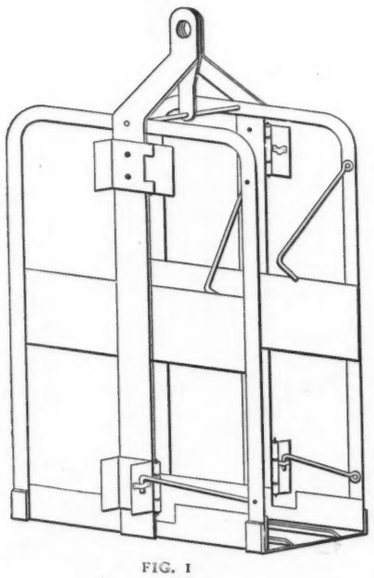


FIG. 1

CAGE WITH HINGED SHOES

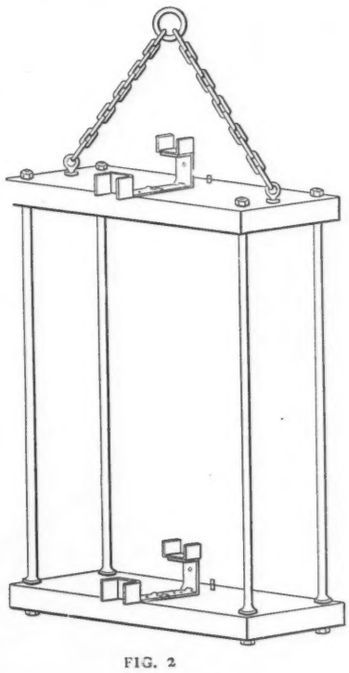


FIG. 2

GIG FOR REPAIRING SHAFT

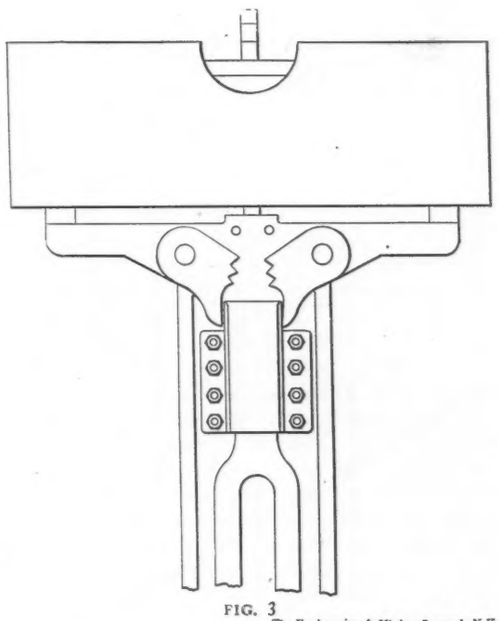


FIG. 3

The Engineering & Mining Journal, N.Y.

SAFETY GRIPPERS WITH LUGS

HINGED SHOES FOR CAGES

This type of shoe was designed for use in the main shaft where skips are ordinarily employed for hauling both men and ore. Occasionally, however, it is necessary to use a cage, as, for instance, in raising mullock in trucks and shifting trucks from level to level or to the surface for repairs. In such cases the cage is fixed on beneath the skip and with the hinged shoe, illustrated in Fig. 1, the cage can be swung into or out of the shaft in a few minutes, without any necessity for removing and replacing a skid in the shaft. The hinged portion of the shoe is folded back, as shown in the top portion of the sketch, until the cage is in position; it is then closed and the bar raised, as shown in the lower portion of the sketch, the bar being firmly secured in position by means of a split pin. This cage is used solely for conveyance of material, all men being strictly forbidden to ride in it.

GIG USED IN SHAFT WORK

The gig was designed for inspecting and repairing timbers in the shaft with a view to affording the timbermen an overhead protection while carrying out this work. Previous practice was for the timbermen to ride on the top of the skip, where they were of necessity exposed to the danger of anything falling down the shaft. The construction of the gig is shown in Fig. 2. It is fitted with a hinged shoe, of a different design from that described above, which allows the gig to be placed in the shaft without removing a skid. It is open on all sides and there is thus ample room for all inspection and repair work. In the ordinary way the gig is hung on beneath the skip, or it may be attached direct to the winding rope. For the work in which it is used the gig of course travels only very slowly through the shaft, so that there is no danger of breaking the bolts that hold the shoe in position.

SAFETY GRIPPERS ON SKIPS

These grippers are of the usual design with the addition of a special toe or lug to prevent the grippers from cutting through the skids in the event of a loaded skid falling in the shaft. When the grippers come into action the toe of the gripper comes into contact with the shoe on the skip just at the point where the grippers have their greatest hold on the runners, and their further penetration into the skids is prevented. This is shown in Fig. 3, herewith.

STEEL CHUTES FOR SHRINKAGE STOPES

For drawing ore from stopes worked on the shrinkage system it is necessary to provide a type of chute that will allow for the breaking of large rocks in the chute itself. Such rocks are invariably found among the ore and their presence there is

*From the *Journal* of the Chamber of Mines of Western Australia, May, 1909.
†Kalgoorlie, W. A.

due either to flaking from the walls of the stope, or to their being buried beneath finer ore during the process of stoping. For this purpose the device called in Australia the "Chinaman" chute is in general use, but recently the Chinaman has been replaced by the steel chutes illustrated in Figs. 4 and 5. The sketches show the whole of the chute, as there is nothing but broken ore behind the timbers. Rocks can be broken in the chute, either by hammer or by blasting with dynamite, without in any way damaging the chute. The lip of the chute is made of ⅜-in. steel and extends only to the back of the framework. This type of chute possessses many advantages over the Chinaman. Two truckers will fill at least twice as many trucks per shift; the necessity for taking off a very high leading stope and the consequent expense of shoveling the extra rock from the level are avoided; stulls can be brought down to a point much nearer the level, where they are more accessible and can be put in with greater ease; repairs are reduced to a minimum and the initial cost of the chute is much less than that of the Chinaman.

Thawing Dynamite

A method of thawing dynamite used by the Vermont Copper Company consists in heating the thawing box by electricity. The box referred to is about 16x40x36 in., and stands on edge. It is made of wood with a number of trays that will slide in and out. Each tray is made of small strips of wood, and it is upon these trays that the powder is placed. Doors are made as nearly airtight as possible. The lower 8 in. of the box has wire coils through which the current is passed, and the heat from the coils warms the box. Above the coils is a thin sheet of galvanized iron, to prevent any powder or nitroglycerin from coming in contact with them. The sheet iron is covered with asbestos sheet. The box is usually thoroughly heated before placing the dynamite on the trays, and then the current is turned off. The thawer is placed in some remote part of the mine and is thoroughly inclosed in a small house, at the end of a drift which can be closed from draft.

Lining for Ore Chutes

The majority of mining companies usually line the bins and ore chutes with sheet steel. It is seldom that the steel sheets are worn uniformly and as soon as a hole occurs it is necessary to renew the entire sheet, which often means a waste of material and extra expense. At Mineville, New York, Witherbee, Sherman & Co. found that it is more economical to use bar steel. At present they use ¾x6-in. bars. By using bars it is less trouble to do repair work and it is necessary to remove only the worn-out part and put in a new piece. All the steel may thus be used. Even short bars with one

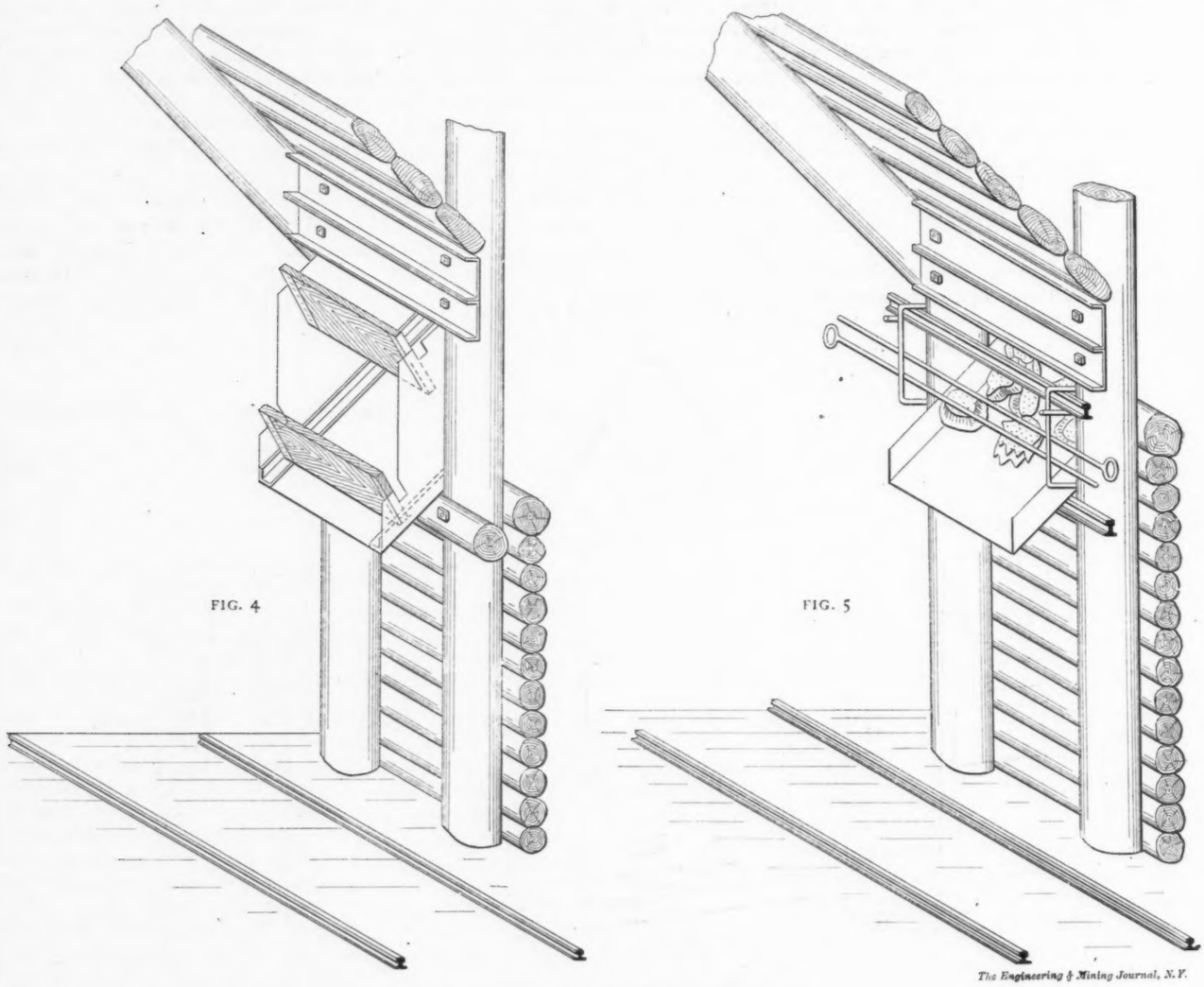


FIG. 4

FIG. 5

The Engineering & Mining Journal, N.Y.

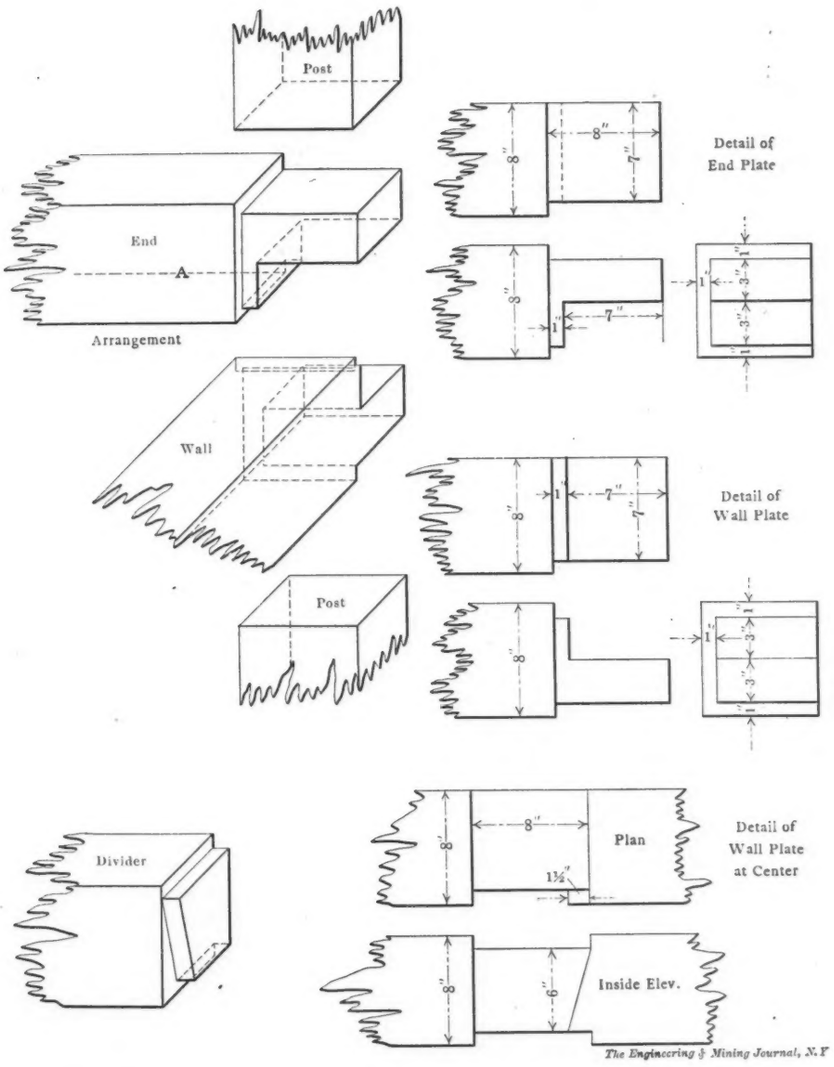
CHUTE FOR ROUGH ORE IN SHRINKAGE STOPES

end worn thin may be used. Railroad rails of heavy weight are also good for lining the front of ore bins at a point directly opposite the place where the cars dump. They are occasionally suspended by the upper end and are free to move at the lower end. They form an excellent buffer for heavy ore as it comes from the mine car or skip.

Selection and Framing of Timber

By W. L. Fleming*

At a small mine in a remote region, timbers have usually to be framed by hand from the logs as a small sawmill is numbered among the things the superintendent wants but cannot get. For shakes use cedar, for split lagging red fir or spruce and sugar pine are preferred. Cedar splits better than the other woods but lacks the strength. The splitting qualities of a tree are gaged by the bark as the general lines of the bark follow the grain of the wood. A tree whose bark shows a slight tendency toward a spiral, is unfit for shakes or lagging. For ordinary mine timbers, the ease of supply carries greatest weight, even gnarled juniper trunks and branches with a shape like the letter S doing duty underground in Nevada. Red fir and spruce are the best of the usually available timbers, then pine. Tamarack is a fair timber, but is very heavy to handle. Black pine is heavy and does not grow to large size. White fir is worthless except for temporary work where no great strain is to be put upon it. Peeled timber will outlast that used with the bark on, especially in damp places.



METHODS OF FRAMING TIMBER

Mine timber should be cut as long as possible before it is to be used, peeled on the spot, and left clear of the ground to season. For shaft timbers, or square setting, it is easier to secure a good fit if the logs are hewn square with a broad-ax. To frame a set from hewn timbers there is necessary a one-man crosscut saw, hand saw, brace and bits, iron square, framing chisel, hand ax, and foot-adze. A templet should be made from inch lumber for the full length and breadth of the desired piece and for as many sides as necessary, one generally being sufficient. Tack the templet lightly to the timber, being sure it remains straight and is not drawn out of line by the inequalities of the hewn edge. Frame from templet, using the square only from templet, never from a hewn edge. Daps and gains not covered by the teplet may be framed from the finished faces already made. Each set should be put together and examined before going into the mine and the joints marked so the set may be put together in the same manner underground.

The accompanying sketch shows the method of framing shaft sets from 8-in. timber which is probably in most common use. It combines the maximum strength with the minimum labor of framing. Angles other than right angles are to be avoided as far as possible. They are hard to fit. To frame this joint, fasten templet to side *A* of wall and end plates and frame top and bottom faces of tongue and shoulder, squaring from the templet. Also frame daps for posts at center of wall plates and mark top and bottom of dap for the divider. The sides may be framed and squared from these faces when finished. The wedge-shaped gain on divider holds the divider on the bottom set and avoids the deep cut in the wall plate necessary for a tongue.

The false set which protects the bottom timbers from the blasts is easier to handle if made of half-round logs without framing. The false wall plates should cover the shaft wall plates over all and are attached by bolts through the holes drilled for the hangers. The false end plates and divider need only reach from one false wall plate to the other and holes should be drilled in the shaft-end plates to accommodate bolts in the same manner as in the wall plates.

A unique winding plant of the Dolcoath tin mine, Cornwall, is described by L. C. Ball (*Queens. Gov. Min. Journ.*, Feb. 15, 1909). In order to prevent angling of the rope, the engine and drums travel from side to side, being mounted on 20 bogies, which run on rails and are worked by tooth gearing from the main shafting. Steam is used at 100 lb. per sq.in., and some difficulty was experienced in bringing it from the stationary boilers to the moving engines, but this was ultimately overcome by the use of three telescopic joints—one fixed, the second running on a curved rail, and the third on a straight rail with the engines.

*Mining engineer, Room 717, 93 Nassau street, New York.

Developments in Nevada County, California

SPECIAL CORRESPONDENCE

In Nevada county, the leading quartz-mining county in California, several new developments of importance are being inaugurated. The Brunswick Consolidated Gold Mining Company, of Grass Valley, of which C. H. Mallen is superintendent, is about to break ground for a new three-compartment shaft, some distance east of the old shaft. It is to be sunk vertically for 1250 ft., whence work will be pushed to the eastward. When the mine closed down last year the works were in rich ore, but it had to be handled so often before reaching the mill that costs became excessive. The rich ore will now be tapped by a new shaft and certain virgin ground will also be opened. The new shaft will be kept free of water by the pumping plant at the old works.

Ground has also been broken for the new Central shaft of the Mountaineer Mines Company at Nevada City. It will be sunk at an angle of 45 deg. to a depth of 2000 ft. The new shaft is 1200 ft. south of the shaft now in use and will be to the mines of the company what the Central shaft is to those of the North Star Mines Company. A powerful hoisting engine has been ordered and a large Lakenan hydraulic pump will also be installed. At present the mine has a 10-stamp mill, but a much larger one will be built. All the machinery will be operated by hydraulic power. The company owns a surface area of about 600 acres, including the following claims: Mountaineer, Layton, Walrath, Rogers, Price, Reward, Arbogast, Black Prince, Langdon, Fortuna, Live Yankee, Orleans and its extensions and East Orleans. The principal owners are John and Peter Bender, of Hamilton, Ohio, and the superintendent is John N. Becker, of Nevada City. Several of the mines named have been producers in their day, and others have been but little developed. At 700 ft. depth in the new shaft a drift will be started to the south to develop the properties of the company south of Deer creek. When the 2000-ft. level is reached a drift will be started north to explore the orebodies north of Deer creek. This drift will be 800 ft. lower than the bottom of the present shaft. The property is one of the most extensive in the State.

A further restitution of coal lands has been made by the Utah Fuel Company, which has recently returned to the Government 800 acres, and in addition has agreed to pay to the Government the sum of $73,000. Recently the company restored to the Government 1440 acres, paid a fine of $8000 and an additional $192,000 for coal extracted from the land.

New Operation in the Tintic District, Utah

SPECIAL CORRESPONDENCE

An interesting mining operation will be undertaken in the Tintic district of Utah by the Eureka City Mines Company, which has been organized by Walter Fitch and associates with a capital of 1,000,000 shares, par $1, for the purpose of acquiring the right to mine under the boundaries of the Eureka townsite. Mr. Fitch announces that his company is prepared to spend $100,000 in the attempt to open up bodies of paying ore under the streets, dwellings, business houses and railroads in the town. A novel method of securing the right to do this work has been hit upon and it is now being subscribed to by the people of the mining camp. It is agreed that no mining or mine openings will be made nearer the surface than 700 ft. and that all property owners shall receive stock in the new company on a basis of 1000 shares for each acre of ground signed up. As the property in the townsite is cut up into small lots, not many, if any of the resident property owners will receive as much as 1000 shares, but in the aggregate, quite a proportion of the company's stock will be issued for this purpose. Working privileges have been obtained from the Chief Consolidated, the property of which is near the townsite, and exploratory work will probably be done from one of the deep levels of that property, if a sufficient number of signatures from the townspeople are obtained to warrant the company in proceeding with the exploration.

Mining Returns in the Transvaal

At the beginning of July there were 78 mines and mills operating in the Transvaal, the mills having a total of 9560 stamps. The total gold yield reported for July was 599,078 oz. fine from the Witwatersrand and 21,716 oz. from the outside districts. The total gold production for July and the seven months ended July 31 was as follows:

	1908.	1909.	Changes.
July, oz.....	584,455	620,794	I. 36,339
Seven months, oz.....	3,984,412	4,257,452	I. 273,040
Seven months, value.....	$82,357,796	$88,001,533	I. $5,643,737

The labor return shows that at the end of July there were 149,474 Kafirs and 5370 Chinese at work in the mines; a net decrease of 4786 Kafirs and 8 Chinamen during the month. As compared with January last there was a net decrease of 5855 Kafirs and 708 Chinese, a total of 6563 laborers. It is claimed by some of the mine managers that 190,000 men could be profitably employed, or 35,000 more than are now at work. The recruiting of negroes for the mines is slower each month, for the reason that there is an increased demand for labor outside the mines, and that kind of work is preferred by the men.

OTHER METALS AND MINERALS

The production of ores, other than gold, for the half year ended, June 30, included 2046 tons copper ore, 1198 tons tin ore and 1054 tons lead ore. The value of other minerals for the half-year was: Flint, £12,850; lime, £33,700; asbestos, graphite, etc., £6742; magnesite, £839; these values making £54,131 in all.

During the half-year diamond production was reported by five companies and 18 individual diggers. The total result shows 3,689,169 loads of dirt washed, the yield being 926,738 carats of diamonds of £580,807 estimated value. The greater part of this production was from the Premier mine.

COAL PRODUCTION

In the first half of 1909 there were 28 collieries in operation in the Transvaal. The total coal mined was 2,381,226 tons, of which 640,594 tons, 26.9 per cent., were sorted or screened out as waste and culm. The total coal sold and delivered during the half-year was 1,736,459 tons; the average price realized being $1.21 per ton at the colliery.

ACCIDENTS

For the six months ended June 30, 1909, there were 1064 separate accidents reported; the total number of casualties being as follows:

	White.	Negro.	Chinese.	Total.
Killed.....	55	586	27	668
Injured...	141	601	39	781
Total....	196	1,187	66	1,449
Per 1000 employed:				
Killed.....	2.46	2.95	2.95	2.90
Injured...	6.29	3.03	4.26	3.39
Total....	8.75	5.98	7.21	6.29

The average number employed for the half-year was 22,403 whites, 198,636 Kafirs and 9153 Chinese; 230,192 in all.

The Russian consul-general at Bushire gives in a report some particulars of recent borings carried out in Arabistan. The oilfield, disclosed by the operations of an English company, appears to be small in area, and the two wells at present working are as deep as 1200 and 750 ft., respectively, but, though no figures are given, it is clear that the Russian consul considers the discovery of great importance. The oil is of good quality, and the development of the field is expected to greatly restrict, if not entirely stifle, the import of Russian and American oil. It is remarkable, having regard only to distances and not to means of communication, that until now American importations of petroleum products have exceeded Russian importations in the ratio of 12 to 1.

Patents Relating To Mining and Metallurgy

A Selected and Classified List of New Inventions Described during the Past Month in the Publications of the Patent Offices

UNITED STATES AND BRITISH PATENTS

A copy of the specifications of any of these patents issued by the United States Patent Office will be mailed by THE ENGINEERING AND MINING JOURNAL upon the receipt of 25 cents. British patents are supplied at 40 cents. In ordering specifications, correspondents are requested to give the number, name of inventor and date of issue.

ALUMINUM

ORE TREATMENT—Method of Treating Aluminum Ores. Frank J. Tone, Niagara Falls, N. Y., assignor to the Carborundum Company, Niagara Falls, N. Y., a Corporation of Pennsylvania. (U. S. No. 929,517; July 27, 1909.)

ORE TREATMENT—Process of Treating Aluminum-Silicate Ores. Frank J. Tone, Niagara Falls, N. Y., assignor to the Carborundum Company, Niagara Falls, N. Y., a Corporation of Pennsylvania. (U. S. No. 929,518; July 27, 1909.)

SILICATES OF ALUMINUM—Process of Treating Silicates of Aluminum for the Purpose of Obtaining Valuable Products. Alf Sinding-Larsen, Christiania, Norway. (U. S. No. 927,758; July 13, 1909.)

ARSENIC

ORE TREATMENT for the Extraction of Metallic Arsenic. G. M. Westman, New York, N. Y. (Brit. No. 3480 of 1908.)

CEMENT

APPARATUS AND PROCESS for Making Cement. Robert W. Lesley, Haverford, and Henry S. Spackman, Ardmore, Penn., assignors to Pine Street Patents Company, a Corporation of New Jersey. (U. S. Nos. 929,144 and 929,145; July 27, 1909.)

COAL AND COKE

BY-PRODUCTS FROM GASES — Process of Obtaining By-Products from Gases of Dry Distillation of Coal. Gustav Hilgenstock, Dahlhausen-on-the-Ruhr, Germany. (U. S. No. 928,974; July 27, 1909.)

COAL-CUTTING MACHINE. Ludwig Schütt, Saarbrücken, Germany. (U. S. No. 931,017; August 10, 1909.)

COKE OVENS—Improvements in Coke Ovens. Theodor von Bauer, Berlin. (Brit. Nos. 6575 and 6845 of 1908.)

COKING PLANT. William R. Elliott, Denver, Colo. (U. S. No. 925,428; June 15, 1909.)

PEAT-CUTTING MACHINE. Otis E. Moulton, Dover, N. H., assignor to New England Fuel Company, Kittery, Me., a Corporation of Maine. (U. S. No. 928,995; July 27, 1909.)

COPPER

ORE TREATMENT—Process of Treating Copper Ores Containing Sulphur. Paul L. T. Héroult, La Praz, France, assignor to Société Electro-Metallurgique Francaise, Froges, France. (U. S. No. 930,666; Aug. 10, 1909.)

PURE COPPER—Process of Obtaining Pure Metallic Copper from a Solution of a Salt of Copper. Lucien Jumau, Paris, France. (U. S. No. 930,968; Aug. 10, 1909.)

REVERBERATORY FURNACES for Refining Copper, etc. A. J. Boult, London, Eng. (Brit. No. 3394 of 1908.)

GOLD AND SILVER

AMALGAMATOR. Elymus Hackett, North Yakima, Wash. (U. S. No. 929,086; July 27, 1909.)

WASHER—Gold and Sand Washer. William R. Graham, Phœnix, Ariz. (U. S. No. 929,586; July 27, 1909.)

IRON AND STEEL

ALLOYS—A Metallurgical Process for Obtaining Alloys and Steels Containing Silicon. Louis H. Baraduc-Muller, Paris. (Brit. No. 14,093 of 1908.)

BLAST-FURNACE-CHARGING APPARATUS. Frank C. Roberts, Philadelphia, Penn. (U. S. No. 929,631; July 27, 1909.)

DRYING AIR for Iron and Other Blast Furnaces. F. W. Harbord, London, Eng. (Brit. No. 4424 of 1908.)

ELECTRIC EXTRACTION of Iron or Other Metals from the Ore. K. A. F. Hiorth, Christiania, Norway. (Brit. No. 3680 of 1908.)

FURNACES—Improvements in Metallurgical Furnaces for Iron and Steel. William F. M. McCarty, Rocky Ridge, Maryland. (Brit. No. 19,356 of 1908.)

ORE TREATMENT—Method of Treating Iron Ore. John T. Jones, Iron Mountain, Mich., assignor to Jones Step-Process Company, Duluth, Minn., a Corporation of Minnesota. (U. S. No. 930,764; Aug. 10, 1909.)

REVERBERATORY REGENERATIVE FURNACE. Thomas S. Blair, Jr., Elmhurst, Ill. (U. S. No. 927,098; July 6, 1909.)

SMELTING—Process of Smelting Iron Oxides. Horace W. Lash, Cleveland, Ohio. (U. S. Nos. 924,676 and 924,677; June 15, 1909.)

SMELTING AND REFINING — An Improved Process of and Apparatus for Smelting and Refining Iron and Steel. William F. M. McCarty, Rocky Ridge, Maryland. (Brit. No. 19,035 of 1908.)

TITANIFEROUS ORES—Process of Treating Titaniferous Iron Ores. Wilhelm Borchers, Aix-la-Chapelle, Germany. (U. S No. 930,344; Aug. 10, 1909.)

NICKEL

ALLOYS—Process of Making Alloys. John T. H. Dempster, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. (U. S. No. 926,980; July 6, 1909.)

ZINC

ALLOY—Process of Making Alloys of Zinc with Copper. Sterling Elliott, Newton, Mass. (U. S. No. 927,843; July 13, 1909.)

EXTRACTION OF ZINC from Its Sulphide by Means of Molten Copper or Iron. T. J. Heskett, Surrey Hills, Victoria, Australia. (Brit. No. 1761 of 1908.)

GALVANIZING—Method of Galvanizing. George L. Patterson, Thomas L. Mornes, and Carl H. Zieme, Newcastle, Penn. (U. S. No. 928,398; July 20, 1909.)

ORE DRESSING—GENERAL

CONCENTRATING-TABLE. John W. Meyers and Daniel F. Paine, Ely, Nev. (U. S. No. 930,553; Aug. 10, 1909.)

CONCENTRATION—Apparatus for Concentrating Ores by Means of Currents of Water. P. F. Peck, Chicago, Ill. (Brit. Nos. 3682 and 3683 of 1908.)

CRUSHING—Stamps for Ore and the Like. Fraser & Chalmers, London, England. (Brit. No. 4038 of 1908.)

ORE-CLASSIFIER. Frank G. Janney, Salt Lake City, Utah. (U. S. No. 928,455; July 20, 1909.)

ORE CRUSHER. Robert S. Watt, Robert B. Watt and Arthur B. Watt, Los Angeles, Cal. (U. S. No. 929,177; July 27, 1909.)

ORE-CRUSHING APPARATUS. Harry W. Hardinge, New York, N. Y., assignor to Hardinge Conical Mill Company, a Corporation of New York. (U. S. No. 928,967; July 27, 1909.)

ORE-FEEDER. Elmer F. Gustafson, Idaho Springs, Colo. (U. S. No. 925,337; June 15, 1909.)

ORE-REDUCING APPARATUS. Wencelas V. Jean, Minneapolis, Minn. (U. S. No. 926,492; June 29, 1909.)

ORE-SEPARATING MACHINE. Wencelas V. Jean, Minneapolis, Minn. (U. S. No. 926,493; June 29, 1909.)

PULP-FEEDER. Joseph B. Green, Wallace, Idaho. (U. S. No. 929,420; July 27, 1909.)

SLIME-BREAKING ATTACHMENT for Ore-Dressing Machines. Joseph O. Dimmick, Los Angeles, Cal. (U. S. No. 927,954; July 13, 1909.)

STAMP-MILL. Joseph P. Rinker, Tres Piedras, N. Mex. (U. S. No. 929,328; July 27, 1909.)

METALLURGY—GENERAL

SMELTER FUMES—Condenser. Hascal A. Hogel, New York, N. Y. (U. S. No. 926,943; July 6, 1909.)

SMELTER FUMES—Process of Condensing Fumes in the Treatment of Refractory Ores. Hascal A. Hogel, New York, N. Y. (U. S. No. 927,241; July 6, 1909.)

SULPHIDE ORE REDUCTION—Improvements in the Reduction of Complex Sulphide and Other Ores. Henry R. A. Silverdale, London, England. (Brit. No. 19,882 of 1908.)

SLAG—Method of Handling Slag, Cinder, etc. John B. Clark, Cleveland, Ohio. (U. S. No. 926,242; June 29, 1909.)

SLAGS—Process of Recovering Volatile Metals and Metalloids, especially Zinc from Lead and Copper Slags. Wilhelm Witter, Hamburg, Germany. (U. S. No. 927,916; July 13, 1909.)

COATING METALS WITH PLATINUM—Process for the Production of a Coating of Platinum on Base Metals not Easily Fusible, such as Iron, Nickel, Cobalt, or the Alloys Thereof. Max Baum, Hanau-on-Main, Germany. (Brit. No. 22,455 of 1908.)

SLAG—Method of Treating Slag. Story B. Ladd, Washington, D. C. (U. S. No. 929,142; July 27, 1909.)

MINING MACHINERY AND APPARATUS

BORING-TOOL. Frederick Thomas, Wigan, England, assignor of one-half to Walker Brothers, Wigan, Limited, Wigan, England. (U. S. No. 930,436; Aug. 10, 1909.)

HOISTING AND DUMPING APPARATUS. Thomas C. Wright, Goldfield, Nev. (U. S. No. 929,530; July 27, 1909.)

MINE-CAR. Thomas W. Weaver and Clyde B. Weaver, Tunnelton, W. Va., assignors of one-third to Scott W. Shahan, Tunnelton, W. Va. (U. S. No. 926,446; June 29, 1909.)

MINE-CARS — Running-Gear for Mine-Cars. John M. Phillips and Robert F. Phillips, Carrick, Penn., assignors to the Phillips Mine and Mill Supply Company, Pittsburg, Penn., a Corporation of Pennsylvania. (U. S. No. 928,066; July 13, 1909.)

ROCK DRILL PACKING—Improvements in Packing for Rock-Drills. Heinrich Flottmann, Cardiff, Wales. (Brit. No. 23,518 of 1908.)

MINE CAGES—Improved Safety Brake for Pit Cages and the Like. James H. Williamson, Dalkeith, Midlothian, Scotland. (Brit. No. 15,892 of 1908.)

MINERS' CANDLE-PROTECTOR. Will Cooper, Black Bear, Idaho. (U. S No. 924,741; June 15, 1909.)

MINERS' LAMPS—Improvements in Miners' Electric Lamps. Communicated from Deutsche Gasglulicht Aktiengesellschaft, Berlin. (Brit. No. 9654 of 1908.)

MINERS' LAMPS—Improveemnts in Miners' Lamp Lighting Appliances. Henry M. Darrah and Frederick Perrins, both of Manchester. (Brit. No. 12,286 of 1908.)

ROCK-DRILL MAKING AND SHARPENING MACHINE. Grant W. Smith, Ottumwa, Iowa. (U. S. No. 927,181; July 6, 1909.)

ROCK DRILLS—Improvements in Rock Drills and Other Pneumatically Operated Tools. Heinrich Flottmann, Cardiff, Wales. (Brit. No. 23,519 of 1908.)

METALLURGICAL MACHINERY AND APPARATUS

MECHANICAL STOKING — Improved Method of and Apparatus for Utilizing Coal or Coke Dust or Like Fuel in Furnaces Fitted with Mechanical Stokers. Thomas D. Stonehouse, Guernsey, Channel Island, Eng. (Brit. No. 13,476 of 1909.)

METALLURGICAL FURNACE. Robert G. Reilly, Corona, N. Y., assignor to North American Reduction Company, a Corporation of Arizona. (U. S. No. 927,283; July 6, 1909.)

REGENERATIVE FURNACES—Reversing Apparatus for Regenerative Furnaces. Thomas S. Blair, Jr., Elmhurst, Ill., assignor, by mesne assignments, to Blair Engineering Company, Chicago, Ill., a Corporation of New York. (U. S. No. 929,277; July 27, 1909.)

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

A. E. Drucker has been visiting the Thames and Waihi districts in New Zealand.

Herbert Haas was in New York this week, on his way home from London to San Francisco.

C. B. Marshall has resigned his position as superintendent of the Gemini mine in the Tintic district, Utah.

Morris Gallagher, of Nevada City, Cal., has been appointed superintendent of the Lucky Boy mine at Hawthorne, Nevada.

E. B. Hinsdale has been chosen a director of the Wolverine Copper Mining Company, to succeed C. R. Corning, resigned.

W. H. Trewartha-James, of Victoria, B. C., general manager of the Tyee Copper Company, was a recent visitor to the exposition at Seattle.

R. G. McConnell, of the Geological Survey of Canada, has gone to Queen Charlotte islands, B. C., to do geological work in some new mining camps.

H. W. deG. Boleo, a mining engineer and special commissioner of the Brazilian government, is visiting the iron mines of the Mesabi range in Minnesota.

George B. Squires has been appointed superintendent of several silver-lead mines, situated in Ainsworth camp, B. C., recently acquired by J. S. Airheart.

It is understood that Frank Fox, of Cincinnati, Ohio, will succeed his brother, the late Martin W. Fox, as president of the Hale & Norcross Mining Company, of Nevada.

S. E. Bretherton, San Francisco, Cal., has been retained by the Lodi Mines Company of Nevada, until its smeltery, to treat extremely rich ore low in lead content, is in successful operation.

Charles Fergie, of Montreal, Canada, is examining the Western Development Company's coal lands in the upper Skeena river district, British Columbia, for British prospective purchasers.

Judd Stewart, assistant to the president of the American Smelting and Refining Company, has been elected a director and member of the executive committee of the American Smelters' Securities Company.

H. Collinson, who since leaving British Columbia for England two or three years ago, had been to the mines of the Famatina Development Corporation, in Argentina, returned recently to Vancouver island.

Ernest Levy, who is associated with Alexander Hill & Stewart, London, is to erect and start in operation a plant for treating ore by the Murex process at the Van Roi mine, Silverton, Slocan, British Columbia.

James McEvoy, geologist for the German Development Company, Ltd., Ottawa, Canada, was at Victoria, B. C., lately, after having spent the summer on the company's Bighorn and Brazeau coal areas in Alberta.

John Seward, recently appointed manager for the New Dominion Copper Company, has commenced his duties in the Boundary district of British Columbia, where are situated the company's copper mines and smeltery.

R. G. Drinnan, formerly superintendent of the Hosmer coal mine, Crow's Nest Pass, B. C., is in Toronto, Ont., after having spent two months examining coal lands in the Brazeau field, north of Banff, Alberta, for a Toronto syndicate.

Lord Grey, governor-general of Canada, has gone to Dawson, on his first visit to Yukon Territory. His party will be joined by Hon. W. Templeman, Dominion minister of mines, and R. W. Brock, director of the Canadian Geological Survey.

E. H. Webster, until recently manager of the Fianza Mining Company at Guanacevi, Durango, has assumed the management of La Republica mine at Ocampo, district of Rayon, Chihuahua, Mexico, under J. Gordon Hardy, consulting engineer.

Charles Emmerson has decided to continue as superintendent of the Bellevue colliery of the West Canadian Collieries, Ltd., near Frank, Alberta, instead of taking charge of the International Coal and Coke Company's mine at Coleman, as it was lately announced he would do.

Thomas Derby has retired from the management of the New Almaden quicksilver mines in Santa Clara county, California. He has been connected with the mine for 45 years, and has been manager for many years. His successor will be Arthur Feust, formerly at the Standard Consolidated mine at Bodie.

Dwight E. Woodbridge, of Duluth, Minn., has been in New York this week, and sailed on the "Mauretania," Aug. 25, for Liverpool. He is on his way to Norway to examine some iron mines for American parties. He intends also to visit the Dunderland iron-ore mines, and those of Kirunavaara and Luossavaara.

Severn P. Ker, vice-president and general manager of sales of the Republic Iron and Steel Company, has resigned, effective Oct. 1 next, and promotions will be made in line. Mr. Ker has become interested in the Sharon Steel Hoop Company and will become its general manager. That company recently increased its capital stock from $1,000,000 to $2,500,000, and will make some important extensions. It is now adding a sixth to its battery of five 40-ton, open-hearth steel furnaces.

B. Britton Gottsberger resigned from the managership of the Tennessee Copper Company in February, 1909, to take the position of general manager of the Miami Copper Company at Globe, Arizona. N. H. Emmons, who has been acting manager since that time has now been appointed general manager. J. V. Bohn is now general superintendent of mines for this company with headquarters at Ducktown, Tenn. The general office of the Tennessee Copper Company is at Copperhill, Tennessee.

Obituary

Robert Reid died suddenly Aug. 21 at Ogunquit, Me., where he was passing a vacation. Mr. Reid was widely known in Canada as an engineer and constructor. He was a member of the Reid syndicate, which built the Newfoundland railway and started the exploration of the mineral resources of the island. He was a member of the Canadian Transcontinental Railway Commission.

S. P. Jellum, who died at Newsome, Idaho, last month, at the age of 40 years, was born in Iowa. After having been two years in the Minnesota State University, he went to the Pacific Coast and there, in the Washington State College, continued his studies. Following his graduation he was engaged in mining engineering and practical mining work in Washington, and last year proceeded to central Idaho, where he made a study of the geology and mineral deposits of the districts he visited. He contributed to the *Northwest Mining News*, published at Spokane, Wash., a series of articles which were afterward issued in book form, entitled, "Some Central Idaho Gold Districts. He was a man of exceptional parts and sterling character, and as a mining engineer enjoyed a good reputation.

Societies and Technical Schools

Canadian Mining Institute—The sixth general meeting of members of the Western branch of the Canadian Mining Institute will be opened at Nelson, B. C., on Saturday, Sept. 25. At the close of the day's session an adjournment will be made to Spokane, Wash., to meet the American Institute of Mining Engineers, which will open its autumn session in Spokane on Sept. 27. It is proposed to hold on one day a joint session of the two institutes at which papers on the "Coal Resources of Southeastern British Columbia and of Alberta" will be read and discussed. Several well known coal-mine managers have promised papers, and much information will be given relative to the coal deposits of the country above mentioned.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at Butte, Denver, Salt Lake City, Goldfield, Cobalt and Toronto

REVIEWS OF IMPORTANT EVENTS

San Francisco

Aug. 18—The Northern Light and Power Company and the Shasta Power Company, having appraised the respective properties, have consolidated under the name of the Sacramento Valley Power Company, and have, near Redding, developed some 4000 h.p. There is water enough to develop 10,000 h.p. and the power lines will soon be extended south from Redding as far as Chico, Butte county.

The water right on the north fork of the Yuba river between Sierra City and Downieville, Sierra county, was taken up years ago and will now be utilized by the Southern Pacific Company, which will locate one of its power plants near Downieville. The water will be diverted below Sierra City for the intake. The mountain stream is very steep at that point, and a large amount of electric power can be generated and the water returned to the river.

John A. Britton, general manager of the San Francisco Gas and Electric Company, has commenced installing a power plant near Horseshoe bar on the middle fork of the American river about three miles from Forest Hill, Placer county. Power will first be furnished to the Cash Rock mine, a few miles from the bar, and the lines will be later carried farther south to several industrial plants.

The men who have been for years quarrying granite at Rocklin and Penryn, Placer county, have formed a committee to visit the San Francisco municipal authorities to urge upon them the use of granite for curbing. This was formerly used exclusively, but since the great fire concrete has been largely substituted, with the result that 19 of the granite quarries out of 24 at Rocklin are in danger of being put out of business altogether.

The committee appointed at the recent Anti-Dredge convention to confer with the members of the California Débris Commission has made a formal call on Captain Jackson, U. S. A., who is secretary of the commission, but they did not get much comfort from the interview. He told the committee that it was not within the province of the commission to gather data on any operation, mining, commercial, or otherwise that did not directly interfere with the navigability of the rivers. The commission has no concern with any damage overflowing waters may do to private lands. A survey of the Feather river is, however, being made below the scene of dredging operations. The California Débris Commission was appointed under an act of Congress to control the operations of hydraulic miners in the drainage basin of the Sacramento and San Joaquin rivers, California. Hydraulic mining, as defined by act of the legislature of the State of California is "mining by means of the application of water, under pressure, through a nozzle, against a natural bank." The gold dredgers do not mine in that way, so that the Débris Commission has no authority to interfere with their operations in any manner. Should, however, a navigable stream be injured, the engineer officers on this coast might interfere, but not as the Débris Commission. The committee will now wait until the commission holds a meeting when they will again bring the matter up. The Federal authorities look upon these matters dispassionately, and will not allow themselves to be drawn into a controversy with which they have no official concern.

The activities at Brandy City, Pike City, and those at Alleghany have stirred up mining matters in eastern Yuba county, as well as in western Sierra county. Around Pike City and that portion of Oregon creek flowing through the Tippecanoe district, a great many locations were made by prospectors this summer. Moreover, a number of old properties which have been lying idle for years are once more being worked.

In Plumas county also, increased activity is apparent in mining matters. Many miners who went to Alleghany, Sierra county, this summer have crossed to the north and gone into Plumas on prospecting trips. Not only Californians, but mining men from Nevada and Colorado are now looking up old mines and prospects in Plumas, trying to get favorable bonds, or else purchasing outright. There is some complaint that prices charged are too high to attract conservative purchasers, but the miners themselves consider that they know what their claims are worth. Now that the long-looked-for Western Pacific railroad is approaching completion the miners in this region will have efficient means of transportation. The many copper properties around Taylorville, Genessee, Crescent Mills and Greenville, which have been partly developed, will be able to ship ores and become of some value to their owners. Plumas is a high mountain county where much snow falls every winter, but it is well wooded and watered and has a large extent of undeveloped mining ground.

In Sierra county, where much quartz mining is now going on, there is complaint of scarcity of hard-rock men. Most of the mines operated there previously have been gravel deposits, but now quartz mining is in the ascendancy.

Denver

Aug. 20—It is reported here that the Doherty Power Company, an offshoot of the Denver Gas and Electric Company, is about to commence the construction of a $6,000,000 plant at the Joplin zinc mines in Missouri, and that the operators have already contracted for 160,000 h.p., which it is estimated is worth $50 per h.p. per annum.

The crosscut from the Kohler, or main, tunnel on the property of the San Antonio company, in the Red Mountain district between Ouray and Silverton, has been completed to a point directly underneath the main shaft, and a raise of 300 ft. will be made to connect. In driving the crosscut, 40 ft. of ore was traversed and this body, it is now ascertained, is not a continuation of that discovered in the shaft, but an entirely separate one, and what is more important, it is of a higher grade in silver, with about the same copper contents. The ore is of the same character (enargite) as that found at the 200 level, the former being 300 ft. deeper, but it carries gray copper, which accounts for the increase in silver contents, as nearly all the San Juan tetrahedrite is rich in silver. The newly discovered orebody will be exploited at once with machine drills. This opening up of what bids fair to prove one of the great mines of that long-neglected and only half-exploited district, will probably revive one of the most sensational producing camps of the San Juan region, which simply had a knock-out by the silver panic of 1893, from which it is only now beginning to recover.

The output of ore in the Silverton district is steadily increasing, and last month reached a total of 3710 tons. This includes 440 tons from the San Antonio.

The extravagant story comes from the Cripple Creek district that an ore-shoot 40 ft. wide has been struck in the Damon mine on Ironclad hill, and that the ore runs from one to four ounces gold per ton without sorting. The property is controlled by the United Gold Mines Company.

The Royal Flush mine, on Hahns peak, has at last sent down its much advertised carload of ore via the Moffat road from Steamboat Springs to a Denver smeltery,

and the ore gave returns of $104 per ton in gold and silver. The ore is brittle and contains some ruby silver, associated with iron pyrites, and of course was closely hand sorted. The vein is a shear zone in the porphyry mountain, and was intersected by a crosscut tunnel which has been driven into the mountain about 800 ft. The ore was discovered 14 years ago, according to the prospectus, and the mine has 5000 ft. of tunnels, drifts and shafts.

In the Gilpin County district, the Topeka mine, in Russell gulch, which has been tied up in litigation for nine years, has passed into the hands of Henry P. Lowe, of Denver, owner and general manager, who will sink the shaft to connection with the Newhouse tunnel, through which the mine will be drained and the ore brought to the surface. This is one of the richest mines in the district, and Mr. Lowe was awarded a gold medal and diploma for a block of its free gold ore shown at the Paris Exposition in 1901.

Butte

Aug. 19—From the latest reports it appears that the troubles of the Panhandle Smelting and Refining Company are nearing an end. It is stated that former president Anderson and Thomas Greenough have come to an agreement which will end the long legal battle which has been waged, and that the plant will be running within 60 days. The smeltery was acquired by interests affiliated with the Montana Mine Owners Association in the early part of the present year and was opperated until March, when T. L. Greenough applied to the Idaho courts for a receiver for the company, alleging overissue of stock and other irregularities on the part of the officers of the Panhandle company. A receiver was appointed who took charge of affairs until June, when the company was thrown into bankruptcy by creditors in sympathy with president Anderson. Bruce Blake now has charge as receiver appointed by the court of bankruptcy. The resumption of operations by the smeltery will be welcomed by the independent mine operators in Montana who, previous to the shutdown, were shipping their ores there for treatment.

Ellen Kleinschmidt, Albert Kleinschmidt and R. A. Kleinschmidt have instituted action against R. H. Kleinschmidt and the American National Bank for the purpose of securing an accounting and enjoining the further payment of certain mining royalties to R. H. Kleinschmidt. The complaint alleges that George H. Boggs is working the property of the American Milling Company under a lease which calls for the payment of certain royalties to the American National Bank for the benefit of the mining company and that by a secret agreement between Boggs, the bank, and defendant Kleinschmidt, who is general manager of the company, Kleinschmidt is receiving 5 per cent. of the royalties which should go to the mining company.

At a recent meeting of creditors of the bankrupt Butte Central & Boston Copper Corporation a final dividend of 7 per cent. was declared, making a total of 11 per cent. which the creditors will receive. The Butte Central Copper Company, the new corporation formed to take over the property and affairs of the old concern, some months ago started to remodel the surface plant at the Ophir mine but the creditors of the old concern prevented the new company from continuing since, under a trust agreement, the creditors were to be paid in full by the new company before it was to receive title to the mine and the payments called for have not as yet been made.

Salt Lake City

Aug. 20—D. C. Jackling, general manager of the Utah Copper Company, returned during the week from the properties of the Ray Consolidated Copper Company, of which he is also general manager. Speaking of this low-grade property, Mr. Jackling said: "Work is still being done to increase the copper-ore reserves, which are now sufficient for many years' supply. Work will be started on the new mill early in the fall and the majority of the plant used in the construction of the Utah Copper mill will be used. It will have a daily capacity of 5000 tons."

The ore bins at the new plant of the International Smelting and Refining Company at Tooele are completed, and it is expected that ore shipments will be received in the near future. The contract of the Utah Consolidated with the American Smelting and Refining Company expires on Jan. 1, and from that time the Utah ores will be sent to the Tooele smeltery. It is planned to blow in the furnaces of the new smeltery about April 1.

Tony Jacobson, president and general manager of the South Columbus Consolidated Company, has prepared a statement for the stockholders relating to the conditions which necessitated the levying of an assessment of 5c. a share on the outstanding capital stock. He shows that there are thousands of tons of ore developed which could not be shipped profitably under existing metal prices and excessive treatment charges. Mr. Jacobson says this will be mined at a good profit when the new plant of the International Smelting and Refining Company and the copper plant of the U. S. smeltery are in commission, as he believes that smelting charges will be reduced.

The Gold Springs Mining and Power Company has placed order with local firms for a complete electrical power plant to be installed near the old Jennie mine in southern Utah. The plant will cost $50,000, and will have a capacity of 300 h.p., which will be doubled within the next six months. General Manager Charles A. Short said that the work of installing the plant will start within the next 10 days. The provision for electrical power in this district will cause a number of mines to open that have not been working for years.

A severe cloudburst in Bingham cañon wrecked part of the plant of the Yampa smeltery. A torrent of water coming down the hill struck part of the smeltery and caused one of the reverberatory furnaces to explode. Two other reverberatories and the blast and converters were not injured. A large force of men are at work on the damaged furnace and the management expect to be able to blow it in in a few weeks.

During the week ending Aug. 13, the shipments of ore and concentrates from the Tintic district were as follows: Centennial Eureka, 47 tons; Uncle Sam, 6; May Day, .2; East Tintic Development Company, 1; Eagle and Blue Bell, 1; Grand Central, 4; Victoria, 4; Sioux Consolidated, 12; Chief Consolidated, 1; Bullion Beck, 1; Mammoth, 1; Ajax, 2; Scranton, 4; Eureka Hill, 1; Utah Consolidated lease, 1; Undine, 1; Iron Blossom, 36; Colorado, 38; and Beck Tunnel, 40.

Goldfield

Aug. 18— The next quarterly meeting of the board of directors of the Goldfield Consolidated Mines Company will be held at Chicago Aug. 26, the meeting place having been changed from New York. The usual quarterly dividend of 30c. per share, amounting to about $1,065,000, will be declared payable Oct. 31 to stockholders of record Sept. 30. The vacancy caused by the resignation of Charles Hayden, of Boston, will also be filled.

George Wingfield, who owns a controlling interest in a number of Goldfield properties, has decided to again adopt the leasing system and intends granting leases on the following properties; the Blue Bull, Columbia Mountain, Conqueror, Berkley, Ethel, Milltown, Kendall, Sandstorm and Booth.

Helena, Montana

Aug. 13—In the case of the St. Louis Mining and Milling Company *vs.* the Montana Mining Company, Ltd., the court found that the defendant had extracted from the Drumlummon vein, belonging to the plaintiff, ore totaling 1912 tons, with a value of $237,470. This ore was extracted beneath the surface of the Nine-Hour claim, north of the 133-ft. plane and east of the compromise strip. The court further found that no ore had been extracted by the plaintiff from the Nine-Hour claim belonging to defendant, but that the plaintiff had taken ore from the compromise strip, belonging to the defend-

ant company, amounting in quantity to 218.29 tons, with a value of $34,341. Thus the St. Louis company has obtained a verdict of $203,129 in its favor. In the previous trial in 1905, the plaintiff was awarded a verdict of $159,000. The judgment of the present trial was ordered to be entered and a stay of execution of 90 days was granted the defendant to prepare and file a bill of exceptions. Between 150 and 200 exhibits were introduced by the two parties, and the testimony submitted covered about 7000 typewritten pages.

The activity in the Corbin-Wickes camp is increasing. Work on the old Alta is in progress, and new machinery is being installed. The only shipper of note in the camp at present is the Blue Bird mine. Several companies, such as the Corbin Copper Company, are employing large forces of men in development work, and are rapidly restoring to the camp its pristine mining activity.

Cobalt

Aug. 21—A number of members of the British Association for the Advancement of Science visited the samp this week to look over some of the properties. They were conducted by Prof. W. G. Miller, provincial geologist, and others of the department.

In drifting on the 75-ft. level of the Silver Leaf the value of the vein was found to increase. In one place there was 8 in. of high-grade ore, but it is extremely irregular, and breaks up into stringers. In surface trenching on the Nipissing to the southwest of Herbert pond a new vein called No. 128, has been discovered. In places it is from 4 to 6 in. in width of smaltite, with high silver contents. The Imperial Crown property, formerly known as the Warner lot, which is now controlled by the Crown Reserve, is doing much trenching. A few days ago a calcite vein 4 in. wide, carrying about 600 oz. in silver was uncovered. The vein has been stripped for about 100 ft., and shows some smaltite.

Among the new companies that have been incorporated, the one of most interest to Cobalt will be the Hudson Bay Mines, headquarters at New Liskeard, with capital of $3,500,000, shares at $1 par value. This company is at present known as the Temiskaming & Hudson Bay. Other new companies incorporated are as follows: Waldman Silver Mines, head office Toronto, capital $2,500,000; Silver Fall Mines, headquarters Niagara Falls, capital $1,000,000; Delaware Cobalt Mining and Exploration Company, headquarters Toronto, capital $40,000; Haileybury Frontier Mining Company, headquarters Haileybury, capital $1,250,000; Doric Reserve Mines, Ltd., headquarters Toronto, capital $1,500,000; Clawson Silver Mines, Ltd., headquarters Toronto, capital $1,500,000; Gowganda Reserve Mines, Ltd., headquarters Toronto, capital $500,000; Argo-Cobalt Mines, Ltd., headquarters Toronto, capital $1,000,000; Northern Mining Company, headquarters Ottawa, capital $100,000.

The Bailey mine has ordered a complete plant, and is now excavating for the necessary buildings. The machinery on order consists of a compressor, 100-h.p. boiler, electric driven hoist, and other necessary equipment. On the John Black property a station is being cut at the 93-ft. level, in the shaft, and from that point a crosscut will be run to cut the cobalt vein on which the shaft was started. The vein dipped from the shaft, and the management expect that only a very short crosscut will be necessary.

On Aug. 15 the camp buildings at the University mine were destroyed by fire. They include bunk house, cook camp and office. The headframe and power house, which were some distance away from the rest of the buildings, escaped, so that work will not be interrupted. The University was a separate mine before the original owners of the La Rose obtained control. The results obtained were not very satisfactory, and in 1907 the mine was shut down and remained closed until the La Rose Consolidated took charge, and started work again. Since that time the outlook for the property has much improved.

In a drilling contest, held in Cobalt Aug. 18 and 19, the first prize of $1000 was taken by the team from the Temiskaming mine, who drilled 43⅛ in. The winners were Page and Pickens, the famous Globe, Ariz., team.

Toronto

Aug. 20—A promising new silver area in the township of Otter about 25 miles north of Thessalon, in Algoma district, is attracting some attention. The first discoveries were made last fall by two prospectors, who kept the matter quiet until they had secured their locations. They disposed of their properties at a good figure. When the find became known a rush followed, and about 100 prospectors are now on the ground and others coming in. Many are from Cobalt and Gowganda. The formation is diabase, in which calcite veins, some of considerable width at the surface, have been discovered, some carrying native silver. The location of a record office for claims at Thessalon is asked for, the nearest at present being at Sault Ste. Marie, 40 miles distant.

The provincial Department of Public Works has received reports to the effect that eight miles of the new wagon road being built from Elk lake to Gowganda has been cleared and grubbed. One hundred men are busy grading, and it is expected that the entire 30 miles of roadway will be complete before winter.

Mexico

Aug. 9—The Southern Pacific Guaymas to Guadalajara line is now operating from Orendain on the Etzatlan branch of the Mexican Central to Tequila, about 25 miles, and is laying track west of Tequila at the rate of a kilometer a day. The road is graded to about 8 km. west of Magdalena, a *puebla* on the north end of Lake Magdalena. Further grading is stopped on acount of the rainy season, and because the line to the west is being resurveyed to find a better route from Quemada west. The present location line is by way of Tequisquite, but the new route runs to the south and more direct to Ixtlan, giving a better grade and shorter route. The road will be completed to Magdalena in about a month, and then will be operating to that point, serving the Cinco Minas property and the San Pedro Analco district. It is likely that a branch will be built from near Magdalena to the Santa Maria branch, which will still better serve these mines, which are now reached from Etzatlan on the Mexican Central branch. When the road is through to Ixtlan the important Hostotipaquillo district will have easy access to rail.

Considerable interest is being taken in the reported discovery of gold, combined with tellurium, in the ore of the San Vicente mine near San Martin de Cal, a few hours southeast of Ameca. The ore is now being tested and interesting results are expected. There is the usual disagreement between different assayers as to the value of gold in the ore and the character of the ore.

One of the most extensive formations of obsidian in Mexico is on the western slope of Mount Tequila extending to Lake Magdalena. It takes more than two hours to cross it on horseback. The obsidian is black and glossy, in thick beds and in masses in beds of volcanic ash. It covers several square miles and is found scattered over neighboring mountains. It has no present commercial use, but was well known to the ancient people of Mexico, who used it extensively for cutting implements and for ornaments.

Johannesburg

The Western Rand Estates Company, which holds a large area on the western extension of the Witwatersrand and which has encountered auriferous banket in several boreholes, considered by many to be the Main Reef, has announced its intention of sinking a shaft to strike the reef at 1500 ft. This is about the least depth at which the sub-outcrop occurs, the boreholes indicating a much greater average. As in the case of most claims in this section the ground is covered by an unconformable sheet of the dolomite and other formations.

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

Alabama

LAUDERDALE COUNTY

It is reported that deposits of phosphate rock have been discovered on a tract covering about 1500 acres of land, about 20 miles north of Florence. J. N. Wilcoxson, Loretto, Tenn., is organizing a company to explore the tract and to work it, if the discoveries are confirmed.

Alaska

Fairbanks—Gold bricks weighing 2400 lbs., and worth more than half a million, recently reached the Seattle postoffice from here, and were sent to the assay office. The gold was in the form of dust and nuggets, accumulated by the Fairbanks Banking Company and the First National Bank of Fairbanks in course of business.

Sitka—The Mills Company, operating on Chicagoff island, of which W. H. Mills, of Sitka, is president, has a new 10-stamp mill installed, and in coöperation with the Chicagoff Mining Company, has built a hydraulic power plant which is to transmit power a distance of five miles to the mines.

Juneau—The Perseverance Gold Mining Company's mine is operating steadily. The transmission wires are now being strung from the power house on Sheep creek to the Perseverence. The power is to be generated by a large stationary gas engine. At Nevada creek, Douglas island, on the Alaska Treasure group, several buildings have been erected and a new tunnel is to be driven in from the bench a distance of 3000 ft. The work is under the direction of D. J. Argall.

Skagway—The North Columbia Gold Mining Company, of Atlin, recently struck a vein of coal on Pine creek. The coal is of good quality.

Arizona

COCHISE COUNTY

Courtland—The Calumet & Arizona is installing another large boiler and two more pumps at its Germania shaft in this district. The Great Western company is shipping to the El Paso smeltery two cars of ore daily from the Mary and Humbolt mines. This is the first ore sent out of Courtland by rail. In the Sulphur Springs valley, near Courtland, a promising prospect is being developed by John Pearce, discoverer of the noted Commonwealth mine at Pearce. The prospect shaft has uncovered a 4-ft. body of copper ore of smelting grade.

Bernoudy-Turkey Creek—New equipment, including two tubular boilers, 415-cu.ft. cross-compound compressor, five 2¼-in. Pacific drills, tram cars, etc., has been installed on the property near Paradise, and further development will be carried out.

PIMA COUNTY

Helvetia—The July report of this company states a profit of $4.62 per ton was netted in the shipment of 1434 tons of ore, which contained 156,268 lb. of copper.

PINAL COUNTY

Ray Northern—Sinking operations are to be resumed on the two-compartment shaft on this company's property, comprising 14 claims three miles east of Ray.

YUMA COUNTY

Harcuvar Copper—Two shifts are at work on the tunnel, now in 260 ft., on this property, 17 miles from Wendendale. R. R. McDonald, superintendent.

Yuma Copper—The company is developing a fine body of oxidized ore at the 130-ft. level of the shaft. The property is near Vicksburg, and the main office of the company is at Houghton, Mich.

California

AMADOR COUNTY

Kennedy Extension Mining Company—This company at Jackson, operating the Muldoon mine, south of the Argonaut, is working on the old shaft which was sunk 15 years ago. An electric hoist is being installed. The shaft is 800 ft. deep.

BUTTE COUNTY

Buck's Ranch—In this vicinity several mines have lately been bonded, including those of H. W. Davenport and G. W. Hoes. There is a five-stamp mill on the latter claim.

Yankee Hill District—A strike of rich gold ore has been made on the Ward place near Yankee hill by Mr. Helms, of Grass Valley, who recently bought the ranch from Ward. The placers in this vicinity yielded largely in early days.

CALAVERAS COUNTY

Hanby—It is understood that operations will soon be resumed at this mine and at the old Hexter tunnel at Mokelumne hill.

Boston—The water has all been taken out of this old mine at Mokelumne hill. The ledge is very wide at the bottom of the 1000-ft. shaft.

Black Metal—An incorporated company has secured control of this mine near Mokelumne hill. The old workings have been abandoned and a new shaft started.

Independent Mining and Milling Company—This company has been incorporated to work a mine of the same name at Vallecito. Hans C. and Alfred Sletten, of Vallecito, and Flora McVaugh, of Los Angeles, are the principal owners.

Standard Amalgamated Exploration—The company has begun operating the Cuneo and K. J. claims at San Antone camp near San Andreas, under the direction of Oliver Reece. The claims will now be known as the Economic mine. New houses have been erected and a 20-stamp mill is being put up.

EL DORADO COUNTY

Mount Pleasant—At this old mine at Grizzly Flat, development work will be extended to the 600 level, and a 10-stamp mill will be erected. A. V. Judson is manager.

Landecker—This mine near Placerville is being reopened by Howard C. Plummer and associates. This is a gravel mine equipped with a mill.

HUMBOLDT COUNTY

Salmon Summit Mining Company—At this property, 32 miles from Hoopa, largely owned by Frank A. Smith, of Arcata, a ledge of high-grade ore has been encountered. A two-stamp mill is being erected. The location is high in the mountains where the snow lies deep, and it can only be worked two-thirds of the year.

INYO COUNTY

Gold Storage—At this new camp northeast of Bishop, a number of locations are being made.

KERN COUNTY

Copper Basin—R. H. Piggott, William H. Schmidt and other Oil Center men are opening a new copper deposit at this place, seven miles west of Randsburg. The property is located on the new railroad. The Castaway silver-lead claims are in the same section.

MADERA COUNTY

Mud Springs—George T. and S. M. Stanhouse and H. Hunter, of Los Angeles, have bonded this mine at O'Neals, and have come to San Francisco to purchase machinery for it. The mine has been idle

for some time, but was formerly a producer.

Fresno Flats—Prospectors have lately found a wide ledge carrying free gold. Fresno Flats was formerly a placer camp.

MARIPOSA COUNTY

Mariposa Commercial and Mining Company—The company is preparing to open the big shaft on the Mariposa property and develop the lower levels. At present, leasers are operating the mine, which is at Mariposa.

MODOC COUNTY

Hoag—It is reported that the money for a custom mill at this camp, Bidwell, has been subscribed. The machinery was ordered some time since, but the man who bought it desired subscriptions from the miners to assist in construction.

MONO COUNTY

Crystal Lake—After some years of development work on the property at Lundy, an increased force will shortly be put on for active production. The company has a 20-stamp mill, machine drills, electric plant, etc., and is well equipped.

NEVADA COUNTY

Peekaboo—The mine at Grass valley has been bonded to C. D. Tregonning.

Pittsburg—A new electric hoist is being installed.

SHASTA COUNTY

Milkmaid—A yield of $13,000 from 160 tons of ore is reported. The mine, which is situated at French gulch, has made its second shipment under the new management; H. F. Musser is manager.

Colorado

LAKE COUNTY—LEADVILLE

Highland Mary—On this property at Breece hill a station was cut at 70 ft. in the shaft and a drift has been driven 40 ft. to the south, in the direction of the Weston fault. Ore shows in the bottom of the shaft and also at the breast of the drift. The high-grade ore is being sacked; also the material from the stringer which contains 45 per cent. bismuth. The balance of the ore is being shipped by carload lots. The lessees are installing an electric hoist.

Alps-Aztec Group—The tunnel to develop this group on Little South Evans gulch, is now in 300 ft. with a depth attained of 178 ft. In another 100 ft., the contact should be reached.

Ballard Dump—Local men have secured a lease on the main dump of this mine located on Breece hill and are shipping 200 tons daily; the ore is sent to the Leadville District mill and an excellent concentrate is turned out. This work will be kept up until snow flies.

Corrine Mountain—Thomas F. Walsh recently visited his two claims in the Mosquito range section and has made an offer to lease several adjoining claims; if accepted, work will be started at once. In one of the Walsh claims the vein crops out at the surface, carrying gold up to 5 oz. per ton.

Martha—At South Evans sinking the new shaft has started, and it will be sent down to the contact, when drifting will be started. The lessees expect to catch the Tenderfoot orebody.

Weston Pass—To the south of the Leadville district, a number of lessees are at work on the Cincinnati and other claims in the section. Lead ore is principally found here; but at present none of the proprietors are shipping, as the work being done is mostly for development purposes.

Houston—From this and adjoining claims at Iowa gulch, under lease to the same people, ore is being regularly shipped to the local smeltery. The ore is silicious, carrying 2 oz. gold per ton.

Wolftone—From the 1250-ft. level of this property at Carbonate hill, 300 tons of lead and zinc ore are being shipped daily; the ore is of such a grade that it is unnecessary to send it through the mill.

Castle View—Development in new territory is the principal work at present being done on this property at Carbonate hill; about 30 tons of ore are being hoisted daily.

Printer Boy—After being idle for several years, the property is now to be developed by J. Clarence Hersey through the Spring Steel tunnel.

SAN MICHEL COUNTY

Walcott & Waltemeyer—This Boulder, Colo., firm has acquired a group of vanadium-bearing claims on Bear creek, near Newmire. Test shipments are being made to determine the advisability of erecting reduction works.

TELLER COUNTY

Old Gold—The company has granted a 12-months' extension of the lease of this Beacon hill property to Joe Brentlinger and associates of Cripple Creek.

Idaho.

COEUR D'ALENE DISTRICT—SHOSHONE COUNTY

H. E. M.—A contract has been placed for the extension of the No. 3 tunnel another 100 ft., the last 100-ft. contract having been completed. The last survey indicated the vein as being 47 ft. from the face.

Copper King—The tunnel is now in 1200 ft. and is in solid quartzite. Work is progressing without timbering. Much water is being encountered.

Canyon Creek Mining Company—A contract for the extension of the lower tunnel 500 ft. has been let to John Weir. Another 400 ft. must be driven to tap the vein. A 3-drill compressor plant was recently installed at the portal of the tunnel.

Samson Mining Company—The claims of this company are near Murray, on Eagle creek. The vein in the present working is now 7½ ft. wide with two perfect walls of quartzite. The drift is in about 325 ft. and the ore is reported to run high in lead and silver.

C. & R. Mining Company—A contract for 200 ft. of crosscutting has been let to E. J. Duff and Jack Wilson.

Bear Top—A good body of ore was recently encountered in the lower workings. The mill at Murray is working steadily and from six to eight cars are shipped per month.

Hypotheek—Favorable ore development continues at the mine at Kingston and a copper furnace may be purchased. Olaf Bergstrom, of Butte, is reporting on the matter.

Handspike—A new hoist for 500-ft. depth, and a new sawmill plant has been ordered, preparatory to development of this copper property on Little North Fork.

NEZ PERCE COUNTY

Idaho Mining—The company is building a second dredge to operate on the high placers adjoining the town of Pierce.

Black Lead Mining Company—On Aug. 17, a report came from Lewiston, Idaho, that the claims, including the Iron Cap, Copper Queen, Black Quartz Lead and Black Lead lodes, were sold to Fred Bradley, president of Bunker Hill & Sullivan Mining Company. From information available it was learned that the deal involved about $100,000. These claims are in the Bitter Root National Forest, three miles east of Rhodes peak on the Idaho side of the Bitter Root range.

Indiana

DECATUR COUNTY

Harvey Steele, county recorder, has been kept busy for a week or more recording oil leases from Monroe township where oil mining is assuming quite a boom. There is little doubt but this new oilfield will prove a bonanza to the land owners. Land values have already increased 50 per cent.

SULLIVAN COUNTY

Thos. L. Lewis, president of the United Mine Workers, has decided several of the disputes submitted to him by the operators' association and the local miners' association and his decision favors the miners. In the Burnett mine dispute he holds that the men were justified in refusing to go through a muddy manway, thus endangering their health. President Lewis stated that while the contract provides for proceedings preliminary to a strike, there was an emergeney in this case and proceedings could not be started. The men were fined the $1 a day as provided

in the contract when they failed to start proceedings toward a settlement. President Lewis holds that this money must be refunded to the men. The operators are greatly disappointed over the ruling and say there is little use to enter into contracts with miners relative to strikes.

As the result of a mass meeting of miners held at Shelburn, an organization has been formed to operate a cöoperative general store. Heretofore the stores were conducted by the operators or their interests.

Kansas

CHEROKEE COUNTY

Ohio Mining Company—Pumps are being installed preparatory to working to the 150 level. Rich runs of sheet zinc ore were encountered in the pump shaft.

Lanyon Zinc Company—On this company's town lots Neil and Crawford have found lead and zinc at 40 ft. Steam machinery is being installed.

Pollard & Co.—Prospect work will be started immediately on a 35-acre lease on the Connor land, which is surrounded by producing tracts.

Straddling Mining Company—An important discovery of lead has been made on the Straddling farm one mile north of Baxter Springs. The strike was made in new territory and at a depth of 75 ft. The drill shows 7 ft. of lead dirt.

Mission Mining Company—The property south of Baxter Springs is again in operation. A new 500-ton plant will be erected soon.

Clermont—A. M. Wagner and associates, of Webb City, Mo., have taken a lease on this land south of Galena.

Baker—This old tract of land at Galena has been leased to Donald Malloy, W. Robinson, et al., Joplin, Mo., and development will be started at once.

Cook & Stone—F. J. Stone and H. S. Cook have secured control of the old Black Hills 40-acre lease, and are installing pumps to drain the entire tract. A large concentrating plant will be erected. The Black Hills tract was a heavy producer when zinc ore sold at $20 a ton.

Michigan

COPPER

Lake—The shaft is down 900 ft. and from the 5th level a crosscut is being driven to cut the formation. Conditions in the drifts are continuing very favorable; the south drift from the 3rd level has again entered good ground, after passing through a small stretch carrying no copper.

Adventure—The new vertical shaft being sunk to tap the three copper-bearing lodes revealed by diamond-drill cores is down about 50 ft. No. 3 shaft has resumed operation after being closed for some time. The company is also carrying on diamond-drill work on various portions of its lands.

Challenge—All work has been suspended at this property, which is owned by the St. Mary's Mineral Land Company. Exploratory work has been carried on at this tract for several years, a large amount of diamond-drill work done and a shaft put down vertically to a depth of about 850 ft. Some copper-bearing rock was revealed in the lateral openings, but nothing of a consistent nature opened.

Hancock—Sinking is going forward at the rate of about 85 ft. per month at the No. 2 shaft, which is down over 1800 ft. From the 18th level a crosscut is being driven toward No. 1 shaft to tap the various lodes and also to take care of the rock coming from the 15th level. An assessment of $2 per share on the outstanding stock has been called to provide funds to carry on this work. A right of way has been secured for the proposed railroad from No. 2 shaft to the site of the stamp mill which was recently acquired.

Ojibway—Sinking is progressing in both shafts. No. 1 shaft is down about 1000 ft. and No. 2, 1100 ft. Sinking will be continued to a depth of 1250 ft. and then temporarily suspended; levels will be established at 950, 1100 and 1250 ft. Drifting on the 800-ft. level between shafts continues, the south drift from No. 1 shaft has been deflected from the foot to the hanging-wall side of the lode; the north drift from No. 2 shaft is in about 130 ft. in good ground.

Keweenaw—Bedrock has been reached in two pits and at these points shafts are to be sunk to determine the value of the Kearsarge lode.

Laurium—This company, which is now under the control of the Calumet & Hecla, has started sinking a shaft to open up the Kearsarge lode. The site of this shaft is about one mile north of the Tecumseh shaft. The overburden at this point is only about 20 feet.

Oneca—This company has started diamond-drill operation on its lands.

Isle Royale—Drifting from the 500-ft. level of the company's "A" shaft, which it is opening on the Baltic lode, has been temporarily suspended and a crosscut is under way to explore the formation. At this point the Baltic lode is nearly 100 ft. wide, with the shaft going down about midway between the footwall and hanging-wall; as there has been practically no copper either in the shaft or the drifts up to this time it has been deemed advisable to drive this crosscut to locate the mineralized portion of the formation. The drill core taken from the site of this shaft showed good copper content in the rock, but it may have gone on either side of the line of the shaft.

South Lake—At a recent meeting of the Aztec company, it was decided to change the name of the company to South Lake, and also to increase the capitalization from 40,000 to 100,000 shares; 20,000 are to be sold at $2 per share, and with these funds exploratory work will be undertaken, diamond drilling to start as soon as possible. The property is situated between the Lake and Adventure properties, with the Copper Range railroad passing through it. R. C. Pryor, of Houghton, is president.

Minnesota

IRON—CUYUNA RANGE

Chesultawney—The first concrete-lined shaft on the new range is to be sunk on this property, near the town of Deerwood. It is owned by the Rogers-Brown Ore Company.

Missouri

JOPLIN—ZINC-LEAD DISTRICT

Aurora Betsey—The shaft is down into 50 ft. of ore.

Alladin—This company at Spring City has completed its mill and has started running. Every mill in the district is now operating. The mills are the Alladin, McKee, Microbe, Alpha, Wilson and Sunrise, all working on the blanket formation.

Hancock—A very rich body of ore has been opened up here at Spring City in an entirely different formation at 144 ft. depth.

McGee—This company at Duenweg has one of the greatest silicate mines in the district producing 9 to 10 tons of high-grade ore a shift. Mr. Krugg, of Joplin, is manager.

Chandler—This mine, south of Spring City, last week made a carload shipment of silicate that assayed 50 per cent., and brought $37 on a $27 base price.

Moler-Smith—Both the large mills at Carl Junction are operating from the open cut. The dirt is loaded with a steam shovel.

Excelsior—This mill, situated at Four Corners, northwest of Joplin, has been completed and is ready to run. D. V. Sholl is manager.

Gundling & Maitland—The company has sold a 20-acre lease on the Brooks land, near Zincite, to O. J. McLane, of Carthage.

Anderson—The Williams Mining and Milling Company, of Kansas City, has opened this old mine in the Chitwood district, near Joplin.

Little Persimmon—The company has nearly completed its 150-ton mill southwest of Carthage.

Natural Gas—The Kansas Natural Gas Company has made arrangements for a greater supply of gas and has rescinded its order of a few weeks ago notifying all the mills that on Dec. 15 fuel gas for mills would be cut off.

Montana

BUTTE DISTRICT

Tuolumne—The management states that at a point about 150 ft. southeast of the shaft on the 1400 level they have cut what is supposed to be the continuation of the North Butte company's Edith May lead. The lead is 20 ft. wide and has been drifted on a distance of 30 ft. Another lead has since been struck on the same level about 80 ft. west of the shaft, which, it is stated, is 46 ft. in width and contains 8 ft. of good concentrating ore. Sinking on the shaft, which is now down 1450 ft., has been discontinued and the company will develop the leads on the 1000-, 1200- and 1400-ft. levels. On the 1000 level a crosscut has already been run to the vein, but on the 1200 level no work has been done except the cutting of a station.

Butte Coalition—The company is hoisting about 1750 tons of ore per day, which is being sent to the Washoe smeltry. Favorable developments continue on the first-class orebory on the 1700 level of the Minnie Healy. It is stated that the company is in a position to ship much more heavily whenever market conditions warrant.

JEFFERSON COUNTY

Boston & Alta—The gallows frame from the Hope mine is being transferred to the Alta and the compressor from the old Bullion mine near Basin will also be set up at the Alta.

MISSOULA COUNTY

Ben Hur—About 1000 ft. from the portal the tunnel at Saltese has cut a body of shipping ore.

RAVALLI COUNTY

Girds Creek District—It is reported that Z. Jones, J. B. Shipman and William Bennett have made a strike of gold ore on their claims near Girds creek, twelve miles from Hamilton. The ore is said to assay phenomenally high.

Nevada

ESMERALDA COUNTY—GOLDFIELD

Florence Goldfield—Four card concentrating tables and the amalgamating plates, part of the new equipment for the mill addition, have been placed in position. The new tube mill has arrived and is now being installed. With this new installation the capacity of the mill will be increased to 160 tons per day. While the main shaft is being enlarged to three compartments the ore supply will be drawn from the Little Florence workings which have been connected with the mill by an aërial tramway.

Sandstorm Mining Company—The annual report just issued shows the total work completed to date to be 1733 ft. of drift, 1808 ft. of crosscut, 280 ft. of raise, 273 ft. of winze, and shaft, 551 ft. The property was only operated in May during the past year, when ore yielding $4340 was removed from the dump. Leasing is being adopted.

NYE COUNTY—PIONEER

Aurora Bullfrog—Supt. Joseph Murphy has received instructions to sink an additional 100 ft. and then to crosscut to the orebody opened in the upper levels. If the new devlopment is satisfactory, preparations will be made for the construction of a 40-stamp mill.

New York

ST. LAWRENCE COUNTY

St. Lawrence Pyrites Company—The combined output of the Stella and Anna mines is approximately 10,000 tons per month. The Harz jigs have been replaced by Hancock jigs. A large amount of development work is being done on known orebodies, as well as some prospecting.

Texas

In the coast region, during July, 45 new wells were completed, of which 35 were producers and 10 dry. There were 68 wells under the drill on July 31. Production in July was 710,150 bbl. Shipments by rail were 395,267 bl.; by sea, 322,624; total, 717,891 bbl., or in excess of the production.

Utah

BEAVER COUNTY

Frisco Consolidated—A strike of 4 ft. of ore has been made on the 700-ft. level. The vein is the extension of that in the Horn Silver mine. D. P. Rohlfing, Beaver, Utah, is general manager.

Commonwealth—Plans for larger operations have been formulated, resulting from the development of two good ore showings within the last few months. In the east and west fissures cut by the tunnel, at the depth of 300 ft. from the surface, an oreshoot from 1 to 2 ft. wide has proved to be at least 125 ft. long. N. A. Dunyon is general manager.

Moscow—From 8 to 10 carloads of ore, valued at from $1200 to $1600 each, are being shipped from the mine every month. Two years ago, when the first shipments were made, the ore ran from $400 to $500 per carload.

JUAB COUNTY

East Tintic—An English syndicate has entered the Tintic district and recently bought control of the East Tintic Mining Company, which owns a large group of claims in that district. It is said that the new company will proceed to develop on an extensive scale and make a large milling property out of the mine. A body of ore 18 ft. wide with streaks of varying thickness which run as high as $48 per ton in gold and silver has been opened up in the lode, a fisure vein in quartzite.

May Day—The management is diligently sinking from the 1000- to the 1100-ft. level in order to get under a new orebody. On this upper level the ore extended 24 ft. John Dern, Salt Lake City, is general manager.

Iron Blossom—Production has now started from the old workings and within the last few weeks a body of ore has been opened which permits working in a full face of shipping ore. The face which is being advanced northward is about 3500 ft. from the face of the silver-lead ore in No. 3 working of the Colorado-Sioux Con vein which is being followed southward.

Beck Tunnel—Electric power is being substituted for steam and the new plant will soon be in commission. The power to supply the Beck tunnel has already been contracted.

Swansea Consolidated—Improvements are sufficient to permit further mine development. A powerful pumping plant has been installed along with a reservoir of 2,000,000 gal. capacity. The mine has been unwatered to the 800-ft. level and the large flow of water can now be handled.

Tintic Smeltery—Three of the lead furnaces are now in commission and the fourth will be blown in next week. The copper furnace is in readiness to be blown in as soon as sufficient ore accumulates.

SUMMIT COUNTY

Daly-West—Connections have just been made between the main shaft and the tunnel level, the shaft now reaching to the 2100-ft. level. The work of sinking the shaft and raising to meet it from the Ontario tunnel level has been under way for several months and General Manager Ernest Bamberger says that the management is also engaged in crosscutting for the ore in the 1700- and 2100-ft. levels.

Daly-Judge—A compressor will be purchased, which will double the present compressor capacity. Electrical power instead of steam will be used for this new machinery.

Washington

CHELAN COUNTY

Chelan—The Chelan Butte Gold Mining Company shipped a car of high-grade ore to the smeltery. The ore comes from the surface working of the mine.

FERRY COUNTY

Ben Hur—High-grade ore has again been encountered in this property, near Republic. The ore will be treated at the Granby smeltery.

Gem—This mine, near Orient, has resumed operations after a shutdown of several months.

Easter Sunday—A cyanide plant is being installed for the mine, near Orient.

KITTITAS COUNTY

Ellensburg—O. E. Kerstetter, a forest ranger, reports a strike, in the Swauk country on the Jordan and York claim, which mining men say is the best ever made in the State of Washington.

SNOHOMISH COUNTY

Index—Survey was recently made for a 2000-ft. surface tram at the Washington-Iowa mine, to connect the mine with the wagon road. This will facilitate ore shipments and the getting of supplies to the mine.

SPOKANE COUNTY

Tungsten King—O. M. Woods, president, announces that a new mill is in contemplation as a result of the recent strike in No. 1 tunnel.

Canada

ALBERTA—TABER

Canada West Coal and Coke—An agreement, running for two years, has been signed by the company and its miners and, after four months' suspension, work has been resumed.

Lee Lake Coal and Coke Company—Operations will shortly be commenced on this property, 11 miles east of Frank. There are 11 known seams of domestic and steam coal on the property. F. St. C. Farran, Lethbridge, is directing preliminary arrangements.

ALBERTA—PASSBURG

Leitch Colleries, Ltd.—The opening of a new coal mine, at Police flats, east of the company's main workings at Passburg, is in progress. W. L. Hamilton, Passburg, is general manager.

BRITISH COLUMBIA—SLOCAN LAKE

Westmont—A 2-ft. vein of copper-silver ore has been encountered. An air compressor is to be installed to expedite driving an adit 500 ft. below No. 2 tunnel. F. E. Griffiths, Slocan City, is manager.

BRITISH COLUMBIA—NICOLA

Nicola Valley Coal and Coke—A Canadian-Rand 30-drill air compressor has been ordered for delivery in three months. The daily output of coal is to be increased from 400 to 1000 tons. W. H. Armstrong, Vancouver, is managing director.

ONTARIO—COBALT

Ore Shipments—Shipments of ore for the week ending Aug. 14 were as follows: City of Cobalt, 64,000 lb.; Cobalt Central, 41,670; Crown Reserve, 182,800; La Rose, 258,190; McKinley-Darragh, 122,350; Nipissing, 322,390; Peterson Lake, 40,000; O'Brien, 83,200; Silver Queen, 167,350; total, 1,198,750 pounds.

Buffalo—During July 3009 tons of ore were milled. The average assay before milling was 41.55 oz. silver and the silver recovered amounted to 97,985 oz. Milling expenses were $1.627 for labor and $0.211 for supplies.

Kerr Lake—No. 3 shaft is down to the 400-ft. level, and the vein maintains the same phenomenal showing at that depth. A winze is being sunk from this level 100 ft. farther down, which will be the deepest working in the camp. Drifting has been done for 100 ft. on the vein recently found at the 150-ft. level under the Lake; the ore runs high in silver.

Nancy Helen—A vein struck recently in the crosscut near the main shaft at the 100-ft. level has a width of 4 in. and carries silver contents.

Temiskaming—A blind vein 2 in. wide and rich in silver has been encountered in the shaft at a depth of 320 feet.

ONTARIO—GOWGANDA

Bartlett Mines—The shaft is down 112 ft., and from the 100-ft. level a crosscut will be run to cut the vein, which dipped from the shaft at a depth of about 40 ft. from the surface.

Boyd-Gordon—Good ore is showing at the 75-ft. level, and veins have been encountered underground which were not located on the surface.

Blackburn—Drifting has progressed 125 ft. in the tunnel. The vein is about 2 in. wide, and carries very high-grade ore; this is being stoped out. The shaft is down about 80 ft., and the vein was just cut in the bottom. The sinking was interrupted on account of the amount of water.

Bonsall—All underground work has been stopped and the men put on surface prospecting. Two promising surface showings have been located.

QUEBEC—MONTREAL

Pacific Pass Coal Company—This company, a recent flotation, owning 35,000 acres of coal lands near the head waters of the Pembina and MacLeod rivers, Alberta, which will be opened up as soon as the Grand Trunk Pacific Railway is completed to Pembina, has received a report from F. S. Landstreet, of New York, who recently examined the property. He states that the company has 800,000,000 tons of high-grade bituminous coal lying practically all above high-water level, making the workings self-draining and capable of operation by gravity haulage.

YUKON TERRITORY—DAWSON

The Duncan, Highet and Haggert districts are more active this season than ever. A good clean-up is expected. The Big Salmon district is also flourishing.

Mexico

BAJA CALIFORNIA

Boleo—The new copper-smelting plant of this French company is nearing completion. A new power plant with Connersville blowers will supply blast for the eight new furnaces. No converting equipment has yet been provided and the company will continue to ship matte and black copper.

CHIHUAHUA

El Rayo Mines—The report for July states that the mill ran 27 days; ore crushed, 3612 tons; value of ore per ton, $16.46; extraction, 90.39 per cent.; value of product shipped, $47,947; operating expenses, $25,831; operating profit, $22,116.

Encinillas Mines and Smelting Works, Ltd.—The Santa Rosalia smelting plant has made a lead bullion production of over 2300 tons during the past seven months. The product is marked in England. It is stated that additional furnaces will be installed. J. L. Saint-Dizier is the manager in charge.

DURANGO

Mexico Consolidated—A 15-stamp mill has been purchased for installation at Tepehuanes.

GUANAJUATO

Guanajuato Consolidated—The July report states that the mill crushed 7577 tons; estimated value of bullion, 60,000 pesos; concentrates, 62,000 pesos; estimated profit, 48,200 pesos; mill extraction, 95.3 per cent. About 400 ft. of development work was done during the month.

MEXICO

Esperanza—During July the mill operated 25 days, crushing 15,146 tons of ore; estimated value of bullion, $112,133; concentrates, $34,242; estimated net profits, $23,270. Development work aggregated 1013 feet.

South America

ARGENTINA

Famatina Development Corporation, Ltd.—This company, at Santa Florentina in the province of Rioja, smelted during July, 2300 tons of ore, producing 212 tons of 18 per cent. matte and one ton of blister copper, assaying 99 per cent. copper, 23 oz. gold, 450 oz. silver. Estimates are being obtained by the consulting engineers, Hooper & Speak, Salisbury House, London, for briquetting and calcining machinery to handle accumulated fines and flue dust.

BRITISH GUIANA

Exports of gold from the colony for the half year ended with June were 31,343 oz. bullion in 1908, and 30,700 oz. in 1909; a decrease of 573 oz. The bullion reported this year was equal to $533,704, or 25,821 oz. fine gold. Exports of diamonds this year were 2210 carats, valued at $13,994; an increase of $3152 in value.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, Aug. 25—The coal market in the West continues to gain. The demand for steam coal is constantly growing and dealers are beginning to take account of winter stocks for domestic trade. Prices almost everywhere continue low, any increase being prevented by heavy shipments from the mines.

The Lake trade continues rather quiet, and many shippers claim that there must be a rush in October if the Northwest is to have its usual supplies.

The Eastern bituminous trade continues to improve to some extent, though not as rapidly as operators would like to see. West Virginia coal still continues a disturbing element, and most operators are hoping that the New River people will be successful in their attempt to regulate shipments and prices.

The anthracite trade is quiet and steady. Very few of the companies are running their collieries full time, four days a week being the rule. The summer discounts on tidewater prices will terminate next week, but there does not seem to be much rush to anticipate this.

Two coal stocks have been specially active recently. Lehigh Coal and Navigation has advanced heavily and is in demand. There is a report that offers have been made for the controlling interest in this stock, which was pooled three years ago; but nothing is publicly known of the supposed purchasers. The $50 shares of this company have sold as high as $120. Pittsburg Coal has also been active, which has given rise to rumors of a probable change in ownership; but none of these rumors have been confirmed.

Wabash-Pittsburg Terminal Association—Coal-mine operators along the Wabash Pittsburg Terminal railway have formed an association for the purpose of broadening their traffic connections and generally to conserve their mutual interests in the section of the Pittsburg coal district in which they are located. Among the companies represented in the association were the Pittsburg & Southern Coal Company, the Penobscot Coal Company and the Pryor Coal Company. William R. Turney of Greensburg, was elected president, and Thomas Donohoe, secretary-treasurer. The association has its office in the Bessemer building, Pittsburg.

Coal Traffic Notes

Coal and coke tonnages originating on Pennsylvania Railroad lines east of Pittsburg and Erie, year from Jan. 1 to Aug. 14, short tons:

	1908.	1909.	Changes.
Anthracite	3,178,254	3,001,348	D. 176,906
Bituminous	20,162,724	22,096,482	I. 1,933,758
Coke	4,195,605	6,322,704	I. 2,127,099
Total	27,536,583	31,420,534	I. 3,883,951

The total increase this year to date was 14.1 per cent.

Coal and coke traffic of Chesapeake & Ohio Railway, fiscal year ended June 30, short tons:

	Coal.	Coke.	Total.
New River	6,753,304	279,973	7,033,277
Kanawha	5,111,841	30,236	5,142,077
Kentucky	331,100	.....	331,100
Connecting lines	210,683	78,649	289,332
Total, 1908-09	12,406,928	388,858	12,795,786
Total, 1907-08	10,525,382	330,891	10,856,273

Total increase in 1908-9 was 1,939,513 tons, or 18.4 per cent. Deliveries for the year were: Points west of mines, 6,280,024 tons coal and 220,009 coke; points east, 1,516,730 tons coal and 168,849 coke; tidewater, 4,600,883 tons coal; anthracite to line points, 9291 tons.

Coal tonnage of the Buffalo, Rochester & Pittsburg railroad for the fiscal year ended June 30, short tons:

	1907-8.	1908-9.	Changes.
Anthracite	82,189	68,346	D. 13,843
Bituminous	5,849,240	5,186,043	D. 663,197
Total coal	5,931,429	5,254,389	D. 677,040
Coke	476,886	301,386	D. 175,500

Coal and coke were 69.3 per cent. of the total freight carried. The average rate received on all freight in 1908-9 was 0.482c. per ton-mile; the average haul was 155.4 miles.

New York

Anthracite

Aug. 25—The anthracite market continues quiet with about the usual business. Dealers look forward to a little rush next week to save the discount of 10c. At some of the collieries considerable trouble is being experienced from shortage of water owing to the dry weather.

Schedule prices for prepared sizes are now $4.65 for lump, and $4.90 for egg, stove and chestnut, f.o.b. New York harbor. For steam sizes quotations are: Pea, $3.15@3.25; buckwheat, $2.35@2.50; No. 2 buckwheat or rice, $1.70@2; barley, $1.35@1.50; all f.o.b., New York harbor.

Bituminous

The seaboard trade continues to do fairly well, the wave of business last week not having subsided as yet. More orders are coming in from the Far East. The shoalwater ports have not yet waked up but may do so in another week or so. The Sound is doing a little better than recently and New York harbor has a slight fit of activity. All-rail trade continues steady.

Prices continue as they have been for some time. Good Miller vein steam coal can be had at a delivered price which nets $1.30@1.35 at mines, while lower grades bring 90@95c. per ton at mines, and gas coal can be had at 60@65c. per ton at mine for run-of-mine.

Transportation is a little slower, consignments sometimes taking a day or so over the schedule time to come through. There is no question about car supply as yet, though special cars are occasionally hard to get.

In the coastwise trade vessels continue in abundant supply and captains and owners are still willing to shade 5c. a ton to get cargoes. The quoted rates continue unchanged at 60c. from Philadelphia to Boston; 60c. from New York to points around Cape Cod; and 30@40c. for small vessels to Providence and the Sound.

Birmingham

Aug. 23—The coal production in Alabama is still improving and there is a better demand. J. R. Pill, general manager of the Galloway Coal Company, is authority for the statement that the coal trade in this State is picking up and that it will not be long now before the activity will approach conditions that prevailed a couple of years ago. Edward Flynn, State mine inspector, is also authority for the statement that there is an improvement right along in the output at the coal mines. Some healthy contracts have been placed for delivery during the fall and winter. There will be a need for miners shortly, is a prediction that is made.

The coke demand is good and the production is being given attention.

Chicago

Aug. 24—Strength continues in the coal market because of increasing consumption of steam grades, the laying in of stocks of domestic grades early by retailers and the restriction of shipments by mine operators. To the last-named cause most of the strength of the market is due. Little coal is sacrificed to meet demurrage requirements; Eastern as well as Western operators have learned that it is disastrous to make Chicago a dumping ground.

Lump from Illinois and Indiana mines is maintaining its relatively better position by demands for the domestic autumn trade and brings $1.75@2.35 on cars. Run-of-mine is steady at $1.60@1.75 and screenings hold an important place in the steam trade at $1.25@1.55. Smokeless has yet some demurrage sales but is in general held well up to $3.40 for lump and $2.95 for run-of-mine quoted for the best grades. Hocking is fairly well regulated, with moderate, steady demand, at $3@3.15. Anthracite continues in light but well distributed demand.

Cleveland

Aug. 24—Quite a rush of orders has been coming in from large consumers and from dealers. There are signs that a shortage of cars may delay shipments, which are now heavy. Several roads have notified mineowners that their supply of cars for September will be limited.

Prices continue about the same. No. 8 district steam brings $1.90@2.05 for lump; $1.70@1.80 for run-of-mine; $1.30@1.35 for slack. Middle district steam is quoted at $1.85@2 for lump; $1.65@1.75 for run-of-mine; $1.15@1.20 for slack. Massillon coal for domestic use is $2.70 for lump. Pittsburg coal is $2.15@2.25 for lump, and $2@2.05 for run-of-mine.

Indianapolis

Aug. 24—The activity among buyers and consumers which was expected to set in during the month has evidently been realized. Railroad companies report that the coal traffic is unusually heavy and the indications are for a still larger haulage. Indiana steam coal, for which there is an increasing demand has been for some time placed at a decided disadvantage in a number of markets in this and adjoining States because of an alleged excessive exchange rate charged by some of the railroads. The Indiana Railroad Commission has been appealed to, and an effort is being made to lower the rates at connecting points.

Pittsburg

Aug. 24—Demand from local consumers continues fairly good, while Lake shipments are only moderate. Nominal prices remain at $1.20 to retail dealers and $1.10 to manufacturers for mine-run, with slack at 65c., but competition continues keen, prices being shaded 5 or 10c. a ton and occasionally more.

Conellsville Coke—Prices continue to harden, although new buying is not very heavy. There has been considerable shortage of labor, which has retarded the increase in production, but conditions are improving. Prompt furnace coke is quotable 5c. higher, at $1.70@1.75, contract furnace coke being $1.75@1.85. Standard 72-hour foundry coke remains at $2@2.25 for prompt or contract, depending on grade.

The *Courier* reports the production in the Connellsville and lower Connellsville regions in the week ended Aug. 17, at 395,188 tons, substantially the same as in the preceding week. Shipments are reported at 4481 cars to Pittsburg, 7187 cars to points west of Pittsburg and 809 cars to points east of Connellsville, a total of 12,477 cars, a decrease of 100 cars in a week.

Foreign Coal Trade

German Coal Trade—Imports and exports of fuel in German Empire, six months ended June 30, metric tons:

	1908.	1909.	Changes.
Imports:			
Coal	5,559,334	5,420,296	D. 139,038
Brown coal	4,432,288	4,051,445	D. 380,843
Coke	258,576	325,629	I. 67,053
Briquets	94,133	98,947	I. 4,814
Exports:			
Coal	9,838,175	10,320,519	I. 482,344
Brown coal	13,328	15,634	I. 2,306
Coke	1,812,642	1,593,303	D. 219,339
Briquets	802,463	758,514	D. 43,949

The coke exports this year included 16,083 tons sent to the United States.

British Coal Exports—Exports of fuel from Great Britain, together with coal sent abroad for the use of steamers engaged in foreign trade, seven months ended July 31, long tons:

	1908.	1909.	Changes.
Coal	35,899,500	36,080,190	I. 180,690
Coke	595,429	619,234	I. 23,805
Briquets	912,448	858,171	D. 54,277
Total exports	37,407,377	37,557,595	I. 150,218
Steamer coal	11,141,974	11,288,941	I. 146,967
Total	48,549,351	48,846,536	I. 297,185

The larger exports this year were 6,171,030 tons to France, 5,367,562 to Italy, 5,180,432 to Germany and 2,128,781 tons to Sweden.

Belgian Coal Production—The total coal production in Belgium for the half-year ended June 30 was 11,813,650 metric tons in 1908, and 11,559,745 in 1909; a decrease of 253,905 tons, or 2.1 per cent.

Welsh Coal Prices—Messrs. Hull, Blyth & Co., London and Cardiff, report current prices of coal as follows, on Aug. 14: Best Welsh steam, $4.26@4.32; seconds, $4.08; thirds, $3.96; dry coals, $4.08; best Monmouthshire, $3.60; seconds, $3.48; best small steam, $2.40; seconds, $2.10. All per long ton, f.o.b. shipping port.

Iron Trade Review

New York, Aug. 25—There is not much change to record in the iron and steel markets this week. There is a continuous steady demand and some new buying, but an absence of the rush which existed a few weeks ago.

In pig iron there has been considerable buying, both in the Central West and in Eastern territory. In the West the chief buying has been of basic and bessemer pig, while in the East foundry iron has been more in demand. Prices are generally firm, but show little change. Many sellers are inclined to think that they have nearly reached the limit which can be asked without checking demand, while others say that we will soon be at the point where the possibility of imports will have to be taken into consideration. It is also to be remembered that production is increasing, as quite a number of merchant furnaces are going into blast, as well as more steel-work furnaces.

In finished material the steady demand for bars and plates has brought about advances of $1 a ton in most cases. In sheets and tinplates the advance recorded last week is likely to be held. In structural material there have been fewer larger contracts, but a pretty steady run of small orders, which mount up to a considerable total.

While the present year will go out with a comparatively light rail business, heavy orders are being booked for 1910 delivery. The total so far taken for next year is estimated at between 400,000 and 450,000 tons.

There is nothing new in the Amalgamated strike, but the Sheet and Tin Plate Company seems to be gaining ground.

Republic Iron and Steel Company—The report for the year ended June 30 shows production as follows:

	1907-8.	1908-9.	Changes.
Iron ore mined	1,025,460	1,451,434	I. 425,974
Pig iron made	494,676	678,799	I. 184,123
Finished iron and steel	434,230	565,151	I. 130,921

On June 30, 1909, the unfilled orders on the books reached a total of 392,420 tons, an increase of 108,677 tons over June of last year.

Baltimore

Aug. 23.—Exports for the week included 484,726 lb. tin scrap to Rotterdam. Imports included 224 tons ferromanganese from Liverpool; 6800 tons manganese ore from India; 5760 tons iron ore from Russia; 21,080 tons iron ore from Cuba.

Birmingham

Aug. 23—Southern furnace companies are taking care of regular customers in pig iron, but are not anxious yet for business for next year's delivery. There is not much business going on though inquiries are being received in this territory steadily for iron for future needs. No. 2 foundry is being held firmly at $13.50 per ton. A small lot of No. 1, soft, sold a few days ago at $14.50 per ton. It was a special order and the only significance is in the sounding of a higher price. Confidence is expressed that within a few weeks the level for No. 2 foundry will have reached $14 per ton, and perhaps in October, the price will have gone even above that. The steady buyers in this territory have been notified that their immediate needs will be cared for. The make is holding up well. The month of August will show a better production than for several months. The repair work on

the several furnaces mentioned in the past few weeks is nearing the end. There is a considerable amount of pig iron on furnace yards in this district but it is positively announced that this product does not belong to the producers. At one place where there is a big pile of iron, the statement was made that on the first of the coming month the producing company where the furnaces are, owns not more than 5000 tons of iron. The shipment of iron from this territory is about equal to the make. The visit to this district recently of G. Dominico, representative of the Argentine Central railroad, which road will receive 50,000 tons of steel rail from Ensley, may result in further business. The Tennessee company will deliver this 50,000 tons of rails to Buenos Aires during a period of 12 months.

Chicago

Aug. 24—The strength of the iron market is indicated by the advance of prices to $14 Birmingham ($18.35 Chicago) for No. 2 Southern and to $18 on No. 2 Northern pig iron for ordinary first-half business. That some foundry iron is sold 25 or 50c. under these prices is admitted, but the tendency is upward, especially for Northern. There is little iron remaining to be sold for 1909 delivery, requirements being small and scattering in foundry grades. Large sales are wanting, but the aggregate disposal of small lots makes up a fair amount and melters incline to contract more heavily as the market advances. Several sales of malleable bessemer in lots up to 2000 tons have strengthened the market; foundry iron lots run up to 600 tons. Northern charcoal iron is active at $19.50@20 per ton.

Railroad supplies lead the heavy demand for iron and steel products, practically every line of which continues booming. Coke is in better demand, showing activity at $4.70 for the best Connellsville.

Cleveland

Aug. 24—Shipments of ore continue heavy. Sales are rather slower. Several of the large shippers of merchant ore are practically sold out for the season. Prices are unchanged.

Pig Iron—Business in foundry and basic is active. Some sellers are turning down orders which they believe are of a speculative character. Quotations for local delivery are $16.25@16.50 for bessemer; $16.50@16.75 for No. 2 foundry; $15@15.50 for gray forge; $19.50@20 for Lake Superior charcoal. Prices are firm.

Finished Material—The demand for almost all kinds of material is good. Mills are making many sales, and jobbers report active business. Steel bars are held at 1.35c., Pittsburg basis; local mills have advanced their prices on plates to 1.45c., Cleveland delivery.

Philadelphia

Aug. 25—All kinds of pig iron are being taken, basic as usual leading because of the large increase in steel products. Furnacemen report constant inquiry for future deliveries, some being for 1910 consumption. It is more difficult than ever to make satisfactory arrangements for basic iron, and it is stated today that a further advance will be made soon. It is understood here that basic requirements have been underestimated, and that large supplemental purchases will soon be made. Forge iron is at present more active than for a year or more, and quotations in certain special grades were advanced 50c. yesterday for 60-day delivery. No. 2X foundry is doing well, as all foundry work is improving. Pipe iron is again under negotiations for winter delivery. Present outside quotations are $17.50 for No. 2X foundry and basic, and $16.25 for forge.

Steel Billets—Midsummer activity exists in view of advancing prices and the necessity for supplies during September and October.

Bars—Bars are exceptionally active for immediate delivery. Iron stores are endeavoring to stock up. Small consumers are taking iron all the time. Car builders are in the market for remote deliveries, and there is a disposition to meet their views.

Structural Material—Business has been stimulated during the past week by the anticipation of a further advance. In fact on small orders it has already taken place. The bridge works are endeavoring to preserve some spare capacity to take care of an expected rush of small orders.

Scrap—The new system of buying scrap inaugurated by some steel mills is not pleasing to scrap dealers, but they report good prices for everything they have to sell. Sales for the past week of No. 1 yard scrap and heavy melting steel were double any recent week.

Pittsburg

Aug. 24—New buying in iron and steel products continues comparatively light, while specifications on old contracts are up to the average in July and are entirely satisfactory.

There have been no important changes in prices of finished steel products in the week, but the trend is toward greater strength. In plates and shapes 1.40c. is still done on attractive orders, but a great many small orders are going at 1.45c. The same condition prevails in steel bars, many orders being taken at 1.40c., while only the most desirable business goes at 1.35c. In the past fortnight there have been sales of bars at 1.30c. in the Baltimore district, when the Pittsburg basis was 1.35c., but the lower price is understood to have been withdrawn.

Pig Iron—Pig iron has resumed its advancing tendency after a slight halt. Bessemer iron has scored a clear advance of 50c. a ton in the week, chiefly on the purchases of the Youngstown Sheet and Tube Company, which set out to buy 25,000 tons at $16, Valley. It secured 7500 tons at this price, as reported a fortnight ago, but in the past few days has paid $16.50 for 6500 tons additional, for delivery any time this year, firmly establishing the market at that figure as a minimum. A sale of 1500 tons of bessemer for equal delivery over the first half of next year at $17 has made a market for that delivery, but the majority of furnaces will not quote at all for next year on bessemer. Basic has been quiet and nominally remains at $15.25, Valley, the price done on the last important sales, but is evidently in line for an advance. Foundry iron has been selling in a quiet way for this year's delivery, prices depending largely on brand, and the market is nominally quotable at $15.25@15.75, Valley, for this year, although it is difficult to do the lower price. Sales for next year are assuming more important proportions and the market shows less range. One interest has bought upward of 2000 tons of foundry iron for the first half, paying $16, Valley, for the bulk, but taking some tonnage at $16.25 and even higher, for special brands, and next year's market can be quoted at this range. Forge is quotable at $14.25@14.75, Valley. Pittsburg prices are 90c. higher than Valley.

Ferromanganese—The market has firmed up. In the past few days several moderate-sized lots for early delivery have been sold at $42, Baltimore, or $43.95, Pittsburg, an advance of $1 a ton from last week, while some relatively small sales have been made for next year at $43.50, seaboard.

Steel—The market is very firm, but transactions are light. Quotations remain at $24 for bessemer billets, $25@26 for open-hearth billets and $25.50@26 for sheet-bars, all f.o.b. Pittsburg.

Sheets—The market continues strong, with a good demand, and prices are firmly held at 2.20c. for block and 3.25c. for galvanized; $1.55 per square for painted corrugated roofing and $2.80 for galvanized.

Foreign Iron

German Iron Production—The German Iron and Steel Union reports the make of pig iron by the German furnaces in July at 1,091,059 metric tons, or 23,638 tons more than in June. For the seven months ended July 31, the total make was, in metric tons:

	1908.	1909.	Changes.
Foundry iron	1,308,453	1,375,387	I. 66,934
Forge iron.....	407,519	405,617	D. 1,902
Steel pig.....	570,807	614,404	I. 43,597
Bessemer pig.....	241,213	236,092	D. 5,121
Thomas(basic)pig	4,532,499	4,709,048	I. 176,549
Total..... ...	7,060,491	7,340,548	I. 280,057

The total increase was 4 per cent.

Metal Markets

New York, Aug. 25—The metal markets show comparatively little change during the week. A fair degree of activity is reported, with speculative interest in some lines.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal.	Exports.	Imports.	Excess.
Gold:			
July 1909..	$16,661,782	$ 3,269,885	Exp. $13,391,897
" 1908..	4,845,272	2,949,179	Exp. 1,896,093
Year 1909..	80,496,119	23,405,477	Exp. 57,090,642
" 1908..	58,363,098	29,357,075	Exp. 29,006,172
Silver:			
July 1909..	5,049,366	3,926,117	Exp. 1,123,249
" 1908..	4,930,746	3,039,581	" 1,891,165
Year 1909..	34,409,032	26,798,145	" 7,610,887
" 1908..	30,445,291	24,180,929	" 6,264,362

Exports from the port of New York, week ended Aug. 21: Gold, $1,250,000, to Argentina; silver, $675,990, to London and Paris. Imports: Gold, $94,533; silver, $56,659; both from the West Indies, Mexico and South America.

Gold production of Rhodesia in July is reported by cable at 53,512 oz. fine. For the seven months ended July 31 the total was 353,958 oz., or $7,316,312 in value.

Gold—The price on the open market in London remained through the week at the minimum, 77s. 9d. per oz. for bars and 6s. 4d. for American coin. There was little competition for gold arriving and most of it was taken for Berlin and Vienna. In New York there were exports of $1,250,000 to Argentina and $200,000 to Panama; while $1,750,000 was taken for shipment to Paris later.

Platinum—Demand is improving. Prices are higher, and dealers this weak asked $23@24.50 per oz. for refined platinum, and $28.25 for hard metal; while $19@21 per oz. is paid for good scrap.

Silver—The market has held steady most of the week at 23½d. in London, advancing on buying by China banks to 23⅝ d. and closing steady at that figure.

SILVER AND STERLING EXCHANGE

Aug.	19	20	21	23	24	25
New York....	50⅞	51	51	51	51⅛	51⅛
London.....	23 7/16	23⅛	23½	23½	23 7/16	23⅜
Sterling Ex..	4.8665	4.8665	4.8665	4.8675	4.8700	4.8690

New York quotations, cents per ounce troy, fine silver; London, pence per ounce sterling silver, 0.925 fine.

Exports of silver from London to the East, Jan. 1 to Aug. 12, as reported by Messrs. Pixley & Abell:

	1908.	1909.	Changes.
India.....	£ 5,313,753	£3,841,800	D. £1,471,953
China.....	516,400	1,465,700	I. 949,300
Straits.....	90,510	82,800	D. 7,710
Total.....	£ 5,920,663	£5,390,300	D. £ 530,363

Receipts for the week, £5000 from the West Indies and £208,000 from New York; total, £213,000. Exports, £2000 to Port Said and £61,500 to India; £63,500 in all.

Movement of gold and silver in Great Britain, seven months ended July 31:

	Imports.	Exports.	Excess.
Gold.....	£32,601,416	£23,357,656	Imp. £9,244,760
Gold, 1908...	27,801,227	25,847,038	Imp. 1,954,189
Silver.....	7,357,536	7,658,919	Exp. 301,383
Silver, 1908.	6,106,868	7,700,536	Exp. 1,593,668

The United States furnished this year £2,935,412 of the gold and £6,216,044 of the silver imported.

Copper, Tin, Lead and Zinc

Aug.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. New York, Cts. per lb.	Lead. St. Louis, Cts. per lb.	Zinc. St. Louis, Cts. per lb.
19	13¼ @13⅜	12⅞ @13⅜	59⅛	30 @30⅛	4.37½ @4.42½	4 25 @4.27½	5.65 @5.67½
20	13⅛ @13¼	12⅞ @13⅜	59¾	30⅛ @30¼	4.37½ @4.42½	4 25 @4 27½	5.65 @5.67½
21	13¼ @13¼	12⅞ @13⅜	....	30¼ @30⅜	4.37½ @4.42½	4.25 @4.27½	5.65 @5.67½
23	13⅛ @13¼	12⅞ @13⅜	59 1/16	30⅛ @30⅝	4 37½ @4.42½	4.25 @4.27½	5 62½ @5.67½
24	13⅛ @13¼	12⅞ @13⅜	59⅞	30⅜ @30⅝	4.37½ @4.42½	4 25 @4.27½	5.62½ @5.67½
25	13⅛ @13¼	12⅞ @13⅜	59 3/16	30¼ @30⅜	4.37½ @4.42½	4.25 @4.27½	5.62½ @5.67½

London quotations are per long ton (2240 lb.) standard copper. The New York quotations for electrolytic copper are for cakes, ingots and wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is usually 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands: special brands command a premium.

Copper—A very good business has been done during the week, Aug. 18-25. It is reported, however, that the bulk of the transactions were for export, although some fair business for domestic delivery was also done. The demand was liberally met and generally speaking, it looks as though the market had reached an equilibrium around the current level. Since the 21st inst. there has been a slackening in the demand. The bulk of the business in electrolytic appears to have been done on the basis of 13c., net, cash, New York. About all of the agencies have participated in this business, with considerable competition, those which are nominally asking a slightly higher price being apparently willing to make concessions in order to obtain business. Lake copper has been freely offered at 13¼c., net, cash, New York, although the Calumet & Hecla is still understood to be asking 13¾c. The trade of this company is, however, largely a specialty at certain times, which enables it to be a law unto itself. Some transactions of considerable magnitude in Lake from second hands, which apparently were more or less forced, have been made at prices below the market as quoted from first hands and closely approximating the market for electrolytic. The close is steady at 13⅛@13¼c. for Lake and 12⅞ to 13⅛c. for electrolytic in cakes, wirebars or ingots. The average for casting copper during the week has been 12¾@12⅞ cents.

Copper sheets are 17@18c., base for large lots. Full extras are charged, and higher prices for small quantities. Copper wire is 15c. base, carload lots at mill. Business is good.

The London standard market has fluctuated within narrow limits, and closes practically unchanged at £59 11s. 3d. for spot and £60 10s. for three months. Refined and manufactured sorts we quote: English tough, £63; best selected, £62@63; strong sheets, £74@76.

Exports of copper from New York and Philadelphia for the week were 2340 long tons. Our special correspondent reports exports from Baltimore for the week at 1437 tons copper.

Tin—The operations for higher prices have been successful in creating a considerable following and prices went up practically from day to day. While consumers are taking care not to be caught short, there has been no particular enthusiasm shown on their part, and the advance is altogether out of proportion to the business transacted with the trade.

London closes a little below the top at £137 12s. 6d. for spot and £138 15s. for three months, while business locally is being done at 30¼@30⅜ cents.

Lead—The market is quiet and quotations are unchanged at 4.25@4.27½c. St. Louis and 4.37½@4.42½c. New York.

The London market is neglected at £12 8s. 9d. for Spanish and £12 11s. 3d. for English lead.

Spelter—Transactions were not as heavy as in previous weeks, which in a measure may be due to the fact that smelters are reluctant to offer their current output for sale, on account of the enormous advance in the price of Joplin ore, which has now reached a point where 6c. for spelter would be warranted. It would seem, however, that consumers supplied themselves liberally during the recent activity, and are inclined to await developments. After a small further advance the market relapsed to 5.77½@5.82½c. New York and 5.62½@5.67½c. St. Louis.

New York quotations for spelter Aug. 19-21, inclusive, were 5.80@5.82½c. per lb.; Aug. 23-25, inclusive, 5.77½@5.82½ cents.

London is somewhat higher at £22 2s. 6d. for good ordinaries and £22 7s. 6d. for specials.

Base price of sheet zinc is now 7½c. per lb., f.o.b. La Salle-Peru, Ill., less 8 per cent. discount.

Other Metals

Antimony—The market is quiet, with little demand except for current supplies. Quotations, both for spot and futures, are 8⅝c. per lb. for Cookson's; 8⅜c. for Hallett's; 7½@7¾c. for outside brands.

Aluminum—There is no change in the market. No. 1 ingots can be had at 20@23c. per lb. for large lots. The higher price is that asked by the American maker. The foreign market is in an unsettled condition, and a movement is on foot to secure higher prices.

Quicksilver—The market is quiet and unchanged at $43.50@44 per flask of 75 lb., New York. San Francisco is weaker at $42@43 for domestic orders, and $40@41 for export. London is £8 5s. per flask, but as low as £8 1s. 3d. is quoted by jobbers.

Nickel—Large lots, contract business, 40@45c. per lb. Retail, spot, from 50c. for 2000-lb. lots, up to 55c. for 500-lb. lots. The price for electrolytic is 5c. higher.

Magnesium—Quotations for this metal are $1.25 per lb., New York, in 100-lb. lots; for 5-lb. lots, $1.40 per pound.

Cadmium—Current quotations are 75c. per lb. in 100-lb. lots at Cleveland, Ohio. In Germany 450@475 marks per 100 kg., at factory in Silesia.

British Metal Imports and Exports

Imports and exports of metals in Great Britain, seven months ended July 31, figures in long tons, except quicksilver, which is in pounds:

Metals:	Imports.	Exports.	Excess.	
Copper, long tons	92,973	36,230	Imp.	56,743
Copper, 1908....	98,847	36,317	Imp.	62,530
Tin, long tons....	23,681	24,196	Exp.	515
Tin, 1908.....	26,839	23,784	Imp.	3,055
Lead, long tons..	123,191	28,473	Imp.	94,718
Lead, 1908.....	134,778	32,664	Imp.	102,114
Spelter, l'g. tons.	64,011	4,296	Imp.	59,715
Spelter, 1908....	61,666	4,757	Imp.	56,909
Quicksilver, lb...	2,925,521	556,582	Imp.	2,368,939
Quicksilver, '08	3,021,528	926,701	Imp.	2,094,827
Ores:				
Tin ore and con.	14,068	.....	Imp.	14,068
Tin ore, 1908...	15,559	.....	Imp.	15,559
Pyrites.....	459,734	.....	Imp.	459,734
Pyrites, 1908...	493,773	.....	Imp.	493,773

Copper totals include metallic contents of ore and matte. Exports include re-exports of foreign material. Of the imports in 1909 the United States furnished 175 tons copper matte, 35,329 tons fine copper and 20,327 tons lead. This lead was chiefly Mexican, refined in this country.

Zinc and Lead Ore Markets

Platteville, Wis., Aug. 12—The highest price paid for zinc ore was $50; the base price of 60 per cent. zinc was $49 per ton. The highest price paid for lead ore was $59.50; the base price of 80 per cent. lead ore was $58 per ton.

SHIPMENTS, WEEK ENDED AUG. 21.

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Highland.....	895,600	.....	.....
Benton.....	657,240	67,650	.....
Platteville.....	462,800	73,000	412,700
Hazel Green.....	425,050	.....	.....
Cuba City.....	306,200	85,260	140,140
Days Siding.....	264,000	.....	.....
Harker.....	203,490	.....	.....
Linden.....	193,960	.....	.....
Strawbridge.....	66,000	.....	.....
Total.....	3,474,340	225,910	552,840
Year to Aug. 21.....	84,587,589	4,965,820	7,707,710

In addition to the above there was shipped to the American Zinc Ore Separating Company, 800,930 lb. and to the Joplin Separator Works, 142,000 lb. zinc ore.

Joplin, Mo., Aug. 21—From a high price of $54.50 per ton for zinc sulphide ore, and a base of $51.50 the market slumped at the week-end to a $50 base as highest offering this evening, and slimes were bought today on a $46 base. Zinc silicate ore sold as high as $35 per ton on a base price of $28 per ton of 40 per cent. zinc, ranging down to a $25 base, with one lot selling on a $27.50 base. The average price, all grades, was $47.04. The highest price for lead ore was $60.50, with heavy sales at $60 for next week's delivery. This week's average, all grades, was $58.10 per ton.

The shipment is a little under an average one, while the output was increased several hundred tons by the restarting of idle mills and the starting of a number of new ones. The shipment was 5557 tons, with an output of approximately 6300 tons. The high price of ore is stimulating a probable maximum production, as there is already a shortage of men for shoveling ore in the ground, and each mill to start emphasizes this want.

SHIPMENTS, WEEK ENDED AUG. 21.

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	3,960,260	1,010,710	$128,316
Joplin.....	2,365,290	347,140	68,191
Prosperity.....	477,100	208,210	17,965
Galena.....	690,750	60,110	17,871
Oronogo.....	601,720	.....	15,312
Granby	649,700	22,810	11,417
Duenweg.....	472,520	46,980	11,190
Spurgeon.....	332,760	64,270	9,036
Aurora	386,510	.....	6,634
Carthage.....	244,120	.....	6,103
Miami	199,410	.....	4,387
Quapaw.....	107,450	4,760	2,717
Alba-Neck.....	106,970	.....	2,674
Cave Springs.....	106,750	.....	2,668
Sarcoxie.....	120,070	.....	2,245
Peoria.....	119,960	.....	1,799
Zincite.....	69,200	.....	1,661
Stott City.....	53,620	.....	1,287
Badger	50,120	.....	1,253
Totals	11,114,280	1,764,990	$312,726
34 weeks.....	384,396,560	58,022,130	$8,897,228

Zinc value, the week, $261,438; 34 weeks, $7,327,297
Lead value, the week, 51,288; 34 weeks, 1,569,931

MONTHLY AVERAGE PRICES.

Month.	Zinc Ore. Base Price.		Zinc Ore. All Ores.		Lead Ore. All Ores.	
	1908.	1909.	1908.	1909.	1908.	1909.
January.....	$37.60	$41.25	$35.56	$38.46	$46.88	$52.17
February....	36.63	36.94	34.92	34.37	49.72	50.50
March.....	36.19	37.40	34.19	34.71	49.90	50.82
April.....	35.40	38.63	34.08	37.01	52.47	55.63
May.....	34.19	40.06	33.39	37.42	56.05	56.59
June.....	33.06	44.15	32.07	40.35	60.48	57.52
July.....	34.55	43.06	31.67	41.11	59.90	53.74
August.....	36.53	.....	33.42	.....	60.34	.....
September..	37.63	.....	34.44	.....	54.59	.....
October.....	35.95	.....	33.28	.....	52.63	.....
November...	39.13	.....	35.02	.....	54.53	.....
December...	42.75	.....	39.63	.....	49.68	.....
Year.....	$36.63	.....	$34.31	.....	$53.93	.....

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

Chemicals

New York, Aug. 25—The general market continues to show fair deliveries on contracts, while spot sales are improving slightly.

Copper Sulphate—The market is unchanged, current quotations being $4.22½ per 100 lb. for large orders, carloads or over, and $4.32½@4.47½ per 100 lb. for smaller orders.

Arsenic—There has been little trading in this article, and prices are somewhat easier, quotations being 2⅝@2¾c. per lb. for white arsenic.

Nitrate of Soda—Business continues at a fair rate, and 2.12½c. per lb. is still being quoted for spot. Futures are rather quieter and 2.10c. is named for all positions next year.

Potash Salts—Exports of potash salts from Germany, half-year ended June 30, metric tons:

	1908.	1909.	Changes.
Kainit, kieserite, etc...	272,607	344,867	I. 72,260
Potassium chloride.....	59,787	92,539	I. 32,752
Potassium sulphate....	18,533	27,072	I. 8,539
Pot.-magnesium sul....	65,370	64,674	D. 696
Total.....	416,297	529,152	I. 112,855

Of the exports this year a total of 216,650 tons went to the United States.

Mining Stocks

New York, Aug. 25—In the general stock market the week has shown another professional market with comparatively little public interest. In the early part of the week, fluctuations were generally upward, but in the last three days there was a marked reaction, and the market was very heavy, with slow trading.

The Curb has been inclined to dullness throughout the week, with moderate trading on small fluctuations. In the copper stocks quite a number showed lower quotations, among them Boston Consolidated, Miami and Nevada Consolidated; while Cumberland-Ely and Ohio Copper each gained a fraction. The fluctuations in either direction, however, were small. The Nevada gold stocks were generally steady and rather inclined to be quiet. Cobalts were fairly active, but without any important changes in price. The industrials were the most active and at the same time the weakest section of the market. Southern Iron and Steel and Standard Oil both record losses for the week.

The directors of the Great Northern Ore properties have declared a dividend of $1 per share payable Sept. 15. This is the third dividend; No. 1 was paid Sept. 16, 1907 and No. 2 March 16, 1908, both $1 per share.

Boston, Aug. 24—After a week of uncertain market fluctuations mining shares are looking up again. There was a general decline in prices during the week in sympathy with the weakness of New

York stocks, but sentiment is improved and there is a disposition to take the long side again.

North Butte is again coming in favor and a high at $61 per share was recorded, which represents a gross advance of $5 during the week. Superior Copper also acted well and has had a $4.25 advance to $60.25. Lake Copper had a $3.25 drop in the market today to $34.50, but it was largely the result of a raid. Street talk is that Lake Copper, North Butte and Superior will lead the Boston list when an advance does set.

U. S. Smelting has been an active issue and considerable pool work has been manifest. The price ran off $2.25 to $52.75, but recovered to $54 today. Kerr Lake had an active spell and the result was a $1 advance to $9.37½. Amalgamated followed the course of the New York Exchange and broke $3 to $83, with subsequent recovery of all but a fraction. Parrot has been active at from $33 to $34, and Old Dominion is up $1,50 to $57. The latter stock is reported quite scarce in the market.

Curb trading was of fair amount, but is now in lessened volume. Prices are generally below those of a week ago. First National and Davis-Daly were active features, as was Rhode Island Coal, Henry M. Whitney's enterprise. The latter rose $1 to $10.50. The new promotion, Champion, broke from 28 to 17c. with some slight recovery, and Willet broke to 16c. Eclipse Oil made a low at 10c. Some slight recovery has been made to date.

STOCK QUOTATIONS

NEW YORK Aug. 25	
Name of Comp.	Clg.
Alaska Mine	‡.11
Amalgamated	85⅝
Anaconda	49⅜
Balaklala	2⅛
British Col. Cop.	6⅛
Buffalo Mines	3⅜
Butte Coalition	25⅜
Colonial Silver	‡⅛
Cum. Ely Mining	7⅛
Davis-Daly	6⅞
Dominion Cop	7
Douglas Copper	2
El Rayo	2⅝
Florence	3⅛
Foster Cobalt	‡.32
Furnace Creek	‡.05
Giroux	10
Gold Hill	‡⅛
Goldfield Con	6⅜
Granby	‡104½
Greene Gold	‡½
Greene G. & S.	‡9
Guanajuato	1⅜
Guggen. Exp	200
Hanapah	‡15
Kerr Lake	8⅜
McKinley-Dar	.90
Miami Copper	16⅛
Micmac	¾
Mines Co. of Am.	1⅛
Montezu. of C. R.	27
Mont. Sho. C.	2⅛
Nev. Utah M. & S.	2
Newhouse M. & S.	3⅛
Nipissing Mines	10⅜
Old Hundred	½
Silver Queen	‡.35
Stewart	⅛
Tennessee Cop'r.	‡39
Tri-Bullion	¾
United Copper	10⅜
Utah Apex	‡4⅛
Utah Copper	51⅜
Yukon Gold	5½

‡Last quotation.

BOSTON Aug. 25	
Name of Comp.	Clg.
Adventure	7
Allouez	47¾
Am. Zinc	31
Arcadian	‡4
Arizona Com	43½
Atlantic	11
Boston Con	15
Calumet & Ariz.	107
Calumet & Hecla	680
Centennial	37¾
Copper Range	83
Daly-West	9
East Butte	11½
Franklin	16½
Greene—Can	9½
Hancock	‡10¾
Isle Royal	27½
Keweenaw	‡3½
La Salle	14¾
Mass	7½
Michigan	9
Mohawk	‡61
Nevada	24⅜
North Butte	60¼
Ojibway	10½
Old Colony	‡60
Old Dominion	57
Osceola	146
Parrot	33¾
Quincy	‡91
Rhode Island	‡4¾
Shannon	16
Superior	59½
Superior & Bost.	15¾
Superior & Pitts.	16½
Tamarack	‡68
Trinity	12¾
U. S. Smg. & Ref.	53¾
U.S.Sm. & Re., pd.	51
Utah Con	45¼
Victoria	‡4
Winona	6½
Wolverine	154
Wyandotte	2½

‡Last quotation.

N. Y. INDUSTRIAL	
	Low.
Am. Agri. Chem.	49¾
Am. Smelt. & Ref.	100½
Am.Sm. & Ref., pf.	114½
Colo. Fuel & Iron	46
Federal M. & S.,pf.	‡91½
National Lead	92¾
National Lead, pf.	112⅛
Pittsburg Coal	21
Republic I. & S.	39
Republic I. & S.,pf.	105¾
Sloss-Sheffield	85¾
Standard Oil	‡685
U. S. Steel	77⅞
U. S. Steel, pf.	125⅛
Va. Car. Chem.	48¼

BOSTON CURB	
	Low.
Ahmeek	200
Chemung	15
Chino	8
Globe Con	4½
Gila	9⅝
Mason Valley	2⅝
Ray Central	2⅛
Ray Con	19
San Antonio	9¼
Yuma	2⅜

Furnished by Hornblower & Weeks, N. Y.

ST. LOUIS Aug. 20		
N. of Com.	High.	Low.
Adams	.40	.30
Am. Nettie	.09	.07
Center Cr'k	1.80	1.70
Cent.C.&C.	83 00	81.00
C.C. & C. pf.	82.00	80.00
Cent. Oil	110.00	100.00
Columbia	9.00	7.00
Con. Coal	19.00	18 00
Doe Run	115.00	105.00
Gra. Bimet.	30	.23
St. Joe	12 00	11.00

LONDON Aug. 25			
Name of Com.	Clg.		
	£1	5s	0d
Dolores	0	3	3
Stratton'sInd.	1	5	9
Camp Bird	2	17	6
Esperanza	1	1	3
Tomboy	1	5	6
El Oro	1	5	6
Oroville			

Cabled through Wm. P. Bonbright & Co., N. Y.

NEVADA STOCKS. Aug. 25.
Furnished by Weir Bros. & Co., New York.

Name of Comp.	Clg.
COMSTOCK STOCKS	
Belcher	.90
Best & Belcher	.52
Caledonia	.28
Challar	.28
Comstock	.28
Con. Cal. & Va.	1.30
Crown Point	.82
Exchequer	40
Gould & Curry	.26
Hale & Norcross	45
Mexican	1 02
Ophir	1 27
Overman	.37
Potosi	48
Savage	46
Sierra Nevada	47
Union	51
Utah	.10
Yellow Jacket	98
TONOPAH STOCKS	
Belmont	85
Extension	63
Golden Anchor	...
Jim Butler	11
MacNamara	32
Midway	.20
Montana	94
North Star	02
Tono'h Mine of N.	6.75
West End Con	.31
GOLDFI'D STOCKS	
Adams	01
Atlanta	.15
Blue Bell	03
Booth	.14
C.O.D. Con	.11
Columbia Mt.	12
Comb. Frac	.73
Con. Red Top	...
Cracker Jack	.01
Dia'dfield B. B. C.	.02
Goldfield Belmont	.04
Goldfield Daisy	21
Great Bend	.07
Jumbo Extension	20
Kendall	.02
Lone Star	.03
May Queen	.04
Oro	.07
Red Hill	.07
Sandstorm	07

Name of Comp.	Clg.
Silver Pick	.15
St. Ives	.07
Triangle	.01
BULLFROG STOCKS	
Gibraltar	.02
Homestake King.	...
Mont. Shoshone C.	2.12½
Tramp Cons	.04
MISCELLANEOUS	
Cumberland Ely	7.06½
Giroux	9.87½
Greenwa'r Copper	.04
Nevada Con	23.50
Nevada Hills	.70
Navada Smelting.	.87½
Nevada Wonder	.70
Nevada-Utah	1.87½
Penn-Wyoming	...
Pittsburgh S. Pk.	.50
Ray Central	2.56½
Ray Con	18.75
Round Mt. Sphinx	08

COLO. SPRINGS Aug. 20	
Name of Comp.	Clg.
Acacia	.08¼
C. C. Con	.06¼
Dante	.07¾
Doctor	.09¾
Elkton	.79½
El Paso	.65
Findlay	.11
Gold Dollar	.13¼
Gold Sovereign	.04
Isabella	.23¾
Jack Pot	.08½
Jennie Sample	.07½
Jerry Johnson	.06¼
Lexington	‡.02
Mary McKinney	.49
Pharmacist	.03¼
Portland	.82
U. G. M.	.08
Vindicator	.70
Work	.07¾

Assessments

Company.	Delinq.	Sale.	Amt.
Arcadian, Mich.	Sept. 1	Sept. 31	$0.50
Black Jack Con., Utah	Aug. 16	Sept. 2	0.01
Boulder Cr'k M. & M., Wash.	Aug. 31	Sept. 30	0.01
Columbus Ext., Utah	Aug. 14	Sept. 4	0.01
Con. Virginia, Nev.	Aug. 16	Sept. 7	0.25
Copper Mt. M. & D., Ida	Sept. 7	Oct. 4	0.003
Crown Point, Nev.	Aug. 21	Sept. 17	0.10
East Buffalo, Ida.	Sept. 10	Oct. 10	0.000½
Exchequer, Nev.	Aug. 16	Sept. 13	0.05
Golden Winnie Tungsten, I.	Aug. 23	Sept. 15	0.001
Hancock Con., Mich.	Oct. 10		1.00
Hypotheek, M. & M., Ida.	Aug. 26	Sept. 25	0 005
Laclede, Ltd, Ida.	Aug. 23	Sept. 21	0.003
Lady Washington, Nev.	Aug. 31	Sept. 20	0.05
Massasoit, Utah	Aug. 21	Sept. 14	0.00½
New Hope, Ida.	July 15	Sept. 25	0.002
Pittsburg Con., Utah	Aug. 20	Sept. 17	0.01
Seven Troughs Mon., Nev.	Aug. 18	Sept. 8	0.00½
Springfield M. Co. Ltd, Ida.	Aug. 13	Sept. 13	0.002
Winona, Mich.	Sept. 14		1.00
Utah Con. M. & M.	Aug. 25	Sept. 7	0.001

Monthly Average Prices of Metals

SILVER

Month.	New York.		London.	
	1908.	1909.	1908.	1909.
January	55.678	51.750	25.738	23.834
February	56.000	51.472	25.855	23.706
March	55.365	50.468	25.570	23.227
April	55.505	51.428	25.133	23.708
May	52.795	52.905	24.377	24.348
June	53.663	52.538	24.760	24.166
July	53.115	51.043	24.514	23.519
August	51.683	.....	23.858	.....
September	51.720	.....	23.877	.....
October	51.431	.....	23.725	...
November	49.647	.....	22.933	.....
December	48.766	.....	22.493	.....
Total	52.864	.....	24.402	.....

New York, cents per fine ounce; London, pence per standard ounce.

COPPER

	NEW YORK.				LONDON.	
	Electrolytic		Lake.			
	1908.	1909.	1908.	1909.	1908.	1909.
January	13.726	13.893	13.901	14.280	62.386	57.688
February	12.908	12.949	13.098	13.295	58.786	61.198
March	12.704	12.387	12.875	12.826	58.761	56.231
April	12.743	12.56½	12.928	12.93½	58.331	57.363
May	12.598	12.893	12.788	13.238	57.387	59.338
June	12.675	13.214	12.877	13.548	57.842	59.627
July	12.702	12.880	12.933	13.363	57.989	58.556
August	13.462	.....	13.639	.....	60.500	.....
September	13.388	.....	13.600	.....	60.338	.....
October	13.354	.....	13.646	.....	60.139	.....
November	14.130	.....	14.386	.....	63.417	.....
December	14.111	.....	14.411	.....	62.943	.....
Year	13.208	.....	13.424	.....	59.902	.....

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

TIN AT NEW YORK

Month.	1908.	1909.	Month.	1908.	1909.
January	27.380	28.060	July	29.207	29.125
February	28.978	28.290	August	29.942	.....
March	30.577	28.727	September	28.815	.....
April	31.702	29.445	October	29.444	.....
May	30.015	29.225	November	30.348	.....
June	28.024	29 322	December	29.154	.....
			Av. Year.	29.465	.....

Prices are in cents per pound.

LEAD

Month.	New York.		St. Louis	London.	
	1908.	1909.	1909.	1908.	1909.
January	3.691	4.175	4.025	14.469	13.113
February	3.725	4.018	3.868	14.250	13.313
March	3.838	3.986	3.835	13.975	13.438
April	3.993	4.168	4.051	13.469	13.297
May	4.253	4.287	4.214	12.938	13.225
June	4.466	4.350	4.291	12.600	13.031
July	4.744	4.321	4.188	13.000	12.563
August	4.580	.....	.....	13.375	....
September	4.515	.....	.....	13.125	.....
October	4.351	.....	.....	13.375	.....
November	4.330	.....	.....	13.538	.....
December	4.213	.....	.....	13.156	.....
Year	4.200	.....	.....	13.439	....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

SPELTER

Month.	New York		St. Louis.		London.	
	1908.	1909.	1908.	1909.	1908.	1909.
January	4.513	5.141	4.363	4.991	20.563	21.425
February	4.788	4.889	4.638	4.739	20.875	21.563
March	4.665	4.757	4.527	4.607	21.075	21.438
April	4.645	4.965	4.495	4.815	21.344	21.531
May	4.608	5.124	4.458	4.974	19.906	21.975
June	4.543	5.402	4.393	5.252	19.000	22.000
July	4.485	5.402	4.338	5.252	19.031	21.969
August	4.702	.....	4.556	.....	19.350	...
September	4.769	.....	4.619	.....	19.563	....
October	4.801	.....	4.651	.....	19.750	....
November	5.059	.....	4.909	.....	20.875	....
December	5.137	.....	4.987	.....	20.625	...
Year	4.726	.....	4.578	.....	20.163	....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.